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## **RCRA Facility Investigation**

**CIBA-GEIGY Facility**  
**Cranston, Rhode Island**

***Quality Assurance Documents: Supplement***  
***Part 1***

**Submitted by:**

**CIBA-GEIGY Corporation**  
444 Sawmill River Road  
Ardsley, NY 10502

**January 1992**



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I.D. NO.: RED001194323  
F: 11-9  
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### ***Quality Assurance Documents: Supplement*** ***Part 1***

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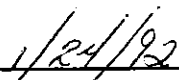
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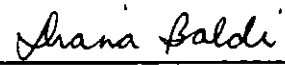
Quality Assurance Documents - Supplement #1  
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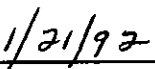
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Approved for CIBA-GEIGY Corporation:

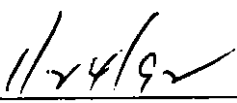
  
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Date

  
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Diana Baldi, National Service  
Contract Administrator

  
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Date

  
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Patty Culver, Database Manager

  
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Date

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- B. Woodward-Clyde Data Collection Quality Assurance Project Plan (QAPjP)
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- D. PACE, Inc., QAPjP
- E. Triangle Labs of Houston QAPjP
- F. Enseco-CAL QAPjP
- G. CIBA-GEIGY Environmental Testing Lab (ETL) QAPjP
- H. CIBA-GEIGY Analytical Chemistry QAPjP
- I. IT Corporation QAPjP for Biological Fieldwork and TIE
- J. IT Corporation QAPjP for Geotechnical Analyses

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### 3.0 PROJECT DESCRIPTION

#### 3.1 Project History

A RCRA Corrective Action Study has been undertaken by CIBA-GEIGY at its former manufacturing facility in Cranston, Rhode Island, pursuant to a Consent Agreement and Order (No. 1-88-1088) entered into by CIBA-GEIGY Corporation and the United States Environmental Protection Agency (USEPA), effective 16 June 1989. The RCRA Corrective Action Study has four stages:

**Stage 1: RCRA Facility Assessment.** In 1987, the USEPA conducted the RCRA Facility Assessment (hereafter called the "Facility Assessment") to identify known and/or suspected releases at the facility requiring further action. The results were presented in the Final RFA Report, CIBA-GEIGY RCRA Facility Assessment (January 1988). In 1988, CIBA-GEIGY conducted a Preliminary Investigation (not required by the Order) to begin characterizing the facility's environment and selected releases. The results of the Preliminary Investigation were summarized in Chapter 1 of the Current Assessment Summary Report (1990).

**Stage 2: RCRA Facility Investigation.** The RCRA Facility Investigation (hereafter simply called the "Facility Investigation") will characterize the nature and extent of any known or suspected releases from Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) that were determined by the Facility Assessment to require further action. The Facility Investigation is being conducted in two phases; CIBA-GEIGY proposed that Phase I be conducted in two parts -- Phases IA and IB -- to obtain additional guidance from the USEPA throughout the project. Phase IA was conducted in late 1989 and mid-1990 to characterize the facility's physical environment more completely; the results of the Phase IA studies were presented in the Phase IA Report (approved in June 1991). Phase IB was conducted in late 1990 and early 1991; it characterized known and/or suspected releases of the facility more completely and also provided additional information about the facility's physical environment. Sampling in

Phase IB was conducted in two rounds. The Phase I Interim Report (submitted in November, 1991) presents the results of both Phases IA and IB. Phase II, scheduled to begin after the USEPA approves the Phase II Proposal, will entail additional site characterization and sampling, the Public Health and Environmental Risk Evaluation (PHERE), and the proposal of Media Protection Standards.

**Stage 3: Corrective Measures Study Proposal.** The Corrective Measures Study (CMS) Proposal describes the measures available to achieve the Media Protection Standards. Work on the CMS Proposal will begin after the USEPA approves the Media Protection Standards.

**Stage 4: Corrective Measures Study Report.** The Corrective Measures Study (CMS) Report evaluates the measures available to achieve the Media Protection Standards at the facility. Work on the CMS Report will begin after the USEPA approves the CMS Proposal.

### **3.2 Site Location and Description**

The site is located in an urban setting in the communities of Cranston and Warwick, Rhode Island. The site adjoins residential areas to the north and south, a commercial area to the east, and open land (which was formerly the site of an industrial facility) to the west. The site slopes gently toward, and is divided by, the Pawtuxet River. The RCRA Corrective Action Study addresses three general areas:

- the on-site area (that is, the site itself);
- the off-site area (exclusive of the Pawtuxet River); and
- the Pawtuxet River.

In addition, the on-site area is divided into three study areas:

- the Production Area;
- the Waste Water Treatment Area; and
- the Warwick Area.

Within the on-site area, 12 SWMUs and two AOCs have been identified at the site. For completeness of the study, CIBA-

GEIGY identified two additional areas of investigation (AAOIs).

### **3.3 Intended Data Uses**

The data collected during the multiple study phases will have various intended uses. Data collection objectives are described in detail in the workplan for each phase; however, in general the data have four main intended uses:

1. To identify compounds positively present in all required media of concern. In doing so, identify the nature and extent of contamination associated with SWMUs, AOCs, AAOIs, and required off-site areas, as appropriate;
2. To provide representative data for assessing potential impacts to public health and the environment;
3. To evaluate remedial options for soil, sediment, and water; and
4. To provide pre-design data for selected remedial options.

### **3.4 Organization of This Document**

This document describes the management system that will be used to ensure that data and information generated during the RCRA Corrective Action Study are technically sound and valid. Overall project quality is the responsibility of CIBA-GEIGY Corporation. In addition, each laboratory and technical consultant under contract to CIBA-GEIGY is responsible for data quality in their realm of expertise. Accordingly, this document was to function as an overall quality assurance management plan developed by CIBA-GEIGY. The appendices contain the Quality Assurance Documents developed by each laboratory and technical consultant performing work which generates data for use in this project. The following ten appendices are attached:

- A. CIBA-GEIGY Database Management Detail
- B. Woodward-Clyde Data Collection Quality Assurance Project Plan (QAPjP)

- C. Savannah Laboratories, Inc., QAPjP Chemical Analysis
- D. PACE, Inc., QAPjP Chemical Analysis
- E. Triangle Labs of Houston QAPjP Chemical Analysis for Dioxins and Furans
- F. Enseco-CAL QAPjP Chemical Analysis for Dioxins and Furans
- G. CIBA-GEIGY Environmental Testing Lab (ETL) QAPjP Chemical Analysis for Treatability Parameters
- H. CIBA-GEIGY Analytical Chemistry QAPjP PCB Screening
- I. IT Corporation QAPjP for Biological Fieldwork and TIE
- J. IT Corporation QAPjP for Geotechnical Analyses

#### **4.0 PROJECT ORGANIZATION AND RESPONSIBILITIES**

##### **4.1 Rationale for Project Organization**

CIBA-GEIGY has carefully selected laboratories and technical consultants who will participate in the RCRA Corrective Action Study. In making its selections, CIBA-GEIGY applied the criteria that each laboratory and technical consultant must have demonstrated (1) expertise in its designated area of responsibility, and (2) the capacity to handle the work in the time frame specified in the order. In addition, because the laboratories and technical consultants must interact with each other, they must be able to function as members of the team. Finally, in the case of analytical laboratories, turn-around-time and contingency back-up was an additional consideration.

##### **4.2 Project Organization**

The project organization, shown on Figure 4-1, identifies the key positions at CIBA-GEIGY, the technical consultants and the laboratories. More detailed organizational charts are provided in the appendices for each laboratory and technical consultant. Figure 4-1 highlights the main communication channels for the Cranston Project.

Within CIBA-GEIGY, there are several individuals contributing to this project from the Corporate Environmental Technology Center (ETC) to support the CIBA-GEIGY project coordinator. ETC is an internal consulting resource available to provide high quality, timely, and cost-effective environmental engineering and analytical services to clients within the CIBA-GEIGY Corporation. The ETC staff and resources are organized into the following technical groups:

- Air Pollution Control
- Water and Wastewater Treatment Technology
- Hazardous Waste Treatment/Geohydrology
- Analytical Technology

The Analytical Technology Group provides high quality,



responsive and cost-effective technical support in three distinct areas of environmental analysis:

- **Environmental Testing Laboratory (ETL)** is a high throughput, certified, compliance laboratory capable of routine to moderately sophisticated analytical support. This laboratory utilizes standard procedures accepted by regulatory agencies and is accredited in multiple states. The lab is capable of implementing and producing EPA Contract Laboratory Program (CLP) deliverables.
- **Analytical Chemistry Group** is a high-technology, non-routine analytical function dedicated to generating engineering quality data in support of characterization and treatability studies. This Group is also the focus for all analytical methods development work.
- **National Service Contract Administration** is a technical and administrative function to select, oversee and manage qualified external environmental laboratories.

In addition to these groups, a Quality Assurance Officer (QAO) ensures that all work meets the stated data quality objectives. This structure positions ETC to be responsive to the diverse technical needs found within CIBA-GEIGY. For the Cranston project, the ETC Analytical Technology Group and the Quality Assurance Officer have assigned responsibilities for the analytical data.

Other internal support to the CIBA-GEIGY project coordinator related to Quality Assurance of the data includes a computer programmer from Corporate Information Services (CIS) for management of the database.

External support for the CIBA-GEIGY project coordinator include the following:

- Woodward-Clyde Consultants for overall project management, including fieldwork, data analysis and report writing;
- HydroQual, Inc., for modeling of the Pawtuxet River;
- International Technology (IT) Corporation for Public Health and Environmental Risk Evaluation of on-site and off-site areas; propose Media Protection Standards; Toxicity Identification Evaluation; and
- Project laboratories for chemical analyses and other analyses, as needed.

#### **4.3 Responsibilities**

**Project Coordinator** - The project coordinator has overall responsibility for meeting the objectives of the study. The project coordinator ensures that appropriate quality assurance plans, health and safety plans, and work plans (including schedules) are written to meet the objectives, and also ensures adherence to the plans through close communications and audits. When a deviation from an approved plan or schedule becomes necessary, it is the responsibility of the project coordinator to discuss the deviation with the USEPA remedial project manager.

**Database Manager** - The database manager is part of the Corporate Information Services (CIS) Group and is responsible for maintaining all hardware and software associated with the database system used to manage data from the project. In addition, the database manager ensures that the data integrity is maintained upon loading, validation and finalization. Once the data is loaded into the system it is the responsibility of the database manager to structure queries appropriately for accurate results and to confirm that the results are reflected accurately in customized reports.

**National Service Contract Administrator (NSCA)** - The NSCA is responsible for selecting laboratories to perform the required analyses, providing technical direction and oversight of the

laboratories. For the Cranston project, both internal and external laboratories will be managed to meet the project objectives. The oversight responsibilities include systems audits of the laboratories (in conjunction with the ETC Quality Assurance Officer) and systems audits of the data validators for compliance to the project-specific Data Validation Worksheets (Appendix B - Attachment #1).

**Quality Assurance Officer** - The QAO is part of the Corporate ETC and is primarily responsible for ensuring that the data quality objectives are met for analyses completed at ETL and ETC Analytical Chemistry. The QAO is also responsible for assisting the NSCA in oversight of the external laboratories performing work for CIBA-GEIGY Corporation. For the Cranston project, the QAO will perform systems audits of the internal and external laboratories as specified in Section 14 in conjunction with the NSCA.

The laboratories selected jointly by the project coordinator and the NSCA utilize a combination of external, contract laboratories, and CIBA-GEIGY's internal laboratories in the ETC Analytical Technology group. For the Cranston project, there are several distinct requirements for analytical data. The main categories of analysis are:

- Appendix IX
  - a) except dioxins/furans
  - b) dioxins/furans<sup>1</sup>
- Site-Specific Compounds
- Treatability Parameters<sup>2</sup>
  - a) POTW/NPDES
  - b) Nutrients
  - c) Major/Minor Ions
  - d) Corrosion/Encrustation

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<sup>1</sup>includes the Appendix IX specified congeners (tetra through hexa-chlorinated dioxins and furans and 2, 3, 7, 8 - TCDD) and additional 2, 3, 7, 8 - chlorinated isomers recommended by CIBA-GEIGY

<sup>2</sup>listed according to terminology presented in the Work Plan

- Geotechnical Parameters
- Bioassay
- Toxicity Identification Evaluation (TIE)
- PCB Screening

The constituents (compounds, analytes, and parameters) related to this project are listed in Table 4.1 and are grouped by the above categories of analysis. Since the PCB screening, TIE, and bioassay test results are not stored in the project database, these categories are not listed in Table 4-1. The nomenclature and CAS numbers in the table are consistent with the database for this project.

Due to the significant amount of analytical data to be collected in a relatively short time frame, a two-tiered management approach is presented for the Appendix IX plus site-specific compounds, the treatability parameters, and the miscellaneous parameters. The approach is to identify two vendors capable of performing the specified analysis while meeting stated data quality objectives of the project equally well. The vendors are identified in Table 4.2 as either the primary lab or the back-up lab for the specified analysis.

TABLE 4-1 Constituents Analyzed for Cranston Project Listed by Category of Analysis.

CATEGORY OF ANALYSIS: APPENDIX IX	
CONSTITUENT NAME	CAS NUMBER
ACENAPHTHENE	83-32-9
ACENAPHTHYLENE	208-96-8
ACETONE	67-64-1
ACETONITRILE	75-05-8
ACETOPHENONE	98-86-2
2-ACETYLAMINOFLUORENE	53-96-3
ACROLEIN	107-02-8
ACRYLONITRILE	107-13-1
ALDRIN	309-00-02
4-AMINOBIPHENYL	92-67-1
ANILINE	62-53-3
ANTHRACENE	120-12-7
ANTIMONY	7440-36-0
ARAMITE	140-57-8
ARSENIC	7440-38-2
BARIUM	7440-39-3
BENZENE	71-43-2
BENZO(A)ANTHRACENE	56-55-3
BENZO(A)PYRENE	50-32-8
BENZO(B)FLUORANTHENE	205-99-2
BENZO(G,H,I)PERYLENE	191-24-2
BENZO(K)FLUORANTHENE	207-08-9
BENZYL ALCOHOL	100-51-6
BERYLLIUM	7440-41-7
ALPHA-BHC	319-84-6
BETA-BHC	319-85-7
DELTA-BHC	319-86-8
GAMMA-BHC	58-89-9
BIS(2-CHLOROETHYL)ETHER	111-44-4
BIS(2-CHLOROETHOXY)METHANE	111-91-1
BIS(2-ETHYLHEXYL)PHTHALATE	117-81-7
BROMODICHLOROMETHANE	75-27-4
BROMOFORM	75-25-2
BROMOMETHANE	74-83-9
4-BROMOPHENYL-PHENYLETHER	101-55-3
2-BUTANONE	78-93-3
BUTYLBENZYLPHTHALATE	85-68-7
CADMIUM	7440-43-9
CARBON DISULFIDE	75-15-0
CARBON TETRACHLORIDE	56-23-5
4-CHLOROANILINE	106-47-8
CHLOROBENZENE	108-90-7

CATEGORY OF ANALYSIS: APPENDIX IX (cont.)	
CONSTITUENT NAME	CAS NUMBER
CHLOROBENZILATE	510-15-6
2-CHLORO-1,3-BUTADIENE	126-99-8
ALPHA-CHLORDANE	5103-71-9
GAMMA-CHLORDANE	5103-74-2
CHLOROETHANE	75-00-3
CHLOROFORM	67-66-3
CHLOROMETHANE	74-87-3
4-CHLORO-3-METHYLPHENOL	59-50-7
2-CHLORONAPHTHALENE	91-58-7
2-CHLOROPHENOL	95-57-8
4-CHLOROPHENYL-PHENYLETHER	7005-72-3
3-CHLOROPROPENE	107-05-1
CHROMIUM	7440-47-3
CHRYSENE	218-01-9
COBALT	7440-48-4
COPPER	7440-50-8
CYANIDE	57-12-5
2,4-D	94-75-7
4,4'-DDD	72-54-8
4,4'-DDE	72-55-9
4,4'-DDT	50-29-3
DIALATE	2303-16-4
DIBENZ(A,H)ANTHRACENE	53-70-3
DIBENZOFURAN	132-64-9
DIBROMOCHLOROMETHANE	124-48-1
1,2-DIBROMO-3-CHLOROPROPANE	96-12-8
DIBROMOMETHANE	74-95-3
1,2-DIBROMOETHANE	106-93-4
DI-N-BUTYLPHTHALATE	84-74-2
1,2-DICHLOROBENZENE	95-50-1
1,3-DICHLOROBENZENE	541-73-1
1,4-DICHLOROBENZENE	106-46-7
3,3'-DICHLOROBENZIDINE	91-94-1
TRANS-1,4-DICHLORO-2-BUTENE	110-57-6
DICHLORODIFLUOROMETHANE	75-71-8
1,1-DICHLOROETHANE	75-34-3
1,2-DICHLOROETHANE	107-06-2
1,1-DICHLOROETHENE	75-35-4
TRANS-1,2-DICHLOROETHENE	156-60-5
2,4-DICHLOROPHENOL	120-83-2
2,6-DICHLOROPHENOL	87-65-0
1,2-DICHLOROPROPANE	78-87-5

TABLE 4-1 Constituents Analyzed for Cranston Project Listed by  
Category of Analysis (cont.)

CATEGORY OF ANALYSIS: APPENDIX IX (cont.)	
CONSTITUENT NAME	CAS NUMBER
CIS-1,3-DICHLOROPROPENE	10061-01-5
TRANS-1,3-DICHLOROPROPENE	10061-02-6
DIELDRIN	60-57-1
DIETHYLPHTHALATE	84-66-2
DIMETHOATE	60-51-5
P-DIMETHYLAMINOAZOBENZENE	60-11-7
7,12-DIMETHYLBENZ(A)ANTHRACENE	57-97-6
3,3'-DIMETHYLBENZIDINE	119-93-7
DIMETHYLPHENETHYLAMINE	122-09-8
2,4-DIMETHYLPHENOL	105-67-9
DIMETHYLPHTHALATE	131-11-3
1,3-DINITROBENZENE	99-65-0
4,6-DINITRO-2-METHYLPHENOL	534-52-1
2,4-DINITROPHENOL	51-28-5
2,4-DINITROTOLUENE	121-14-2
2,6-DINITROTOLUENE	606-20-2
DINOSEB	88-85-7
DI-N-OCTYLPHTHALATE	117-84-0
1,4-DIOXANE	123-91-1
DIPHENYLAMINE	122-39-4
DISULFOTON	298-04-4
ENDOSULFAN I	959-98-8
ENDOSULFAN II	33213-65-9
ENDOSULFAN SULFATE	1031-07-8
ENDRIN	72-20-8
ENDRIN ALDEHYDE	7421-93-4
ETHYLBENZENE	100-41-4
ETHYL METHACRYLATE	97-63-2
ETHYL METHANESULFONATE	62-50-0
ETHYL PARATHION	56-38-2
FAMPHUR	52-85-7
FLUORANTHENE	206-44-0
FLUORENE	86-73-7
HEPTACHLOR	76-44-8
HEPTACHLOR EPOXIDE	1024-57-3
HEXACHLOROBENZENE	118-74-1
HEXACHLOROBUTADIENE	87-68-3
HEXACHLOROCYCLOPENTADIENE	77-47-4
HEXACHLOROETHANE	67-72-1
HEXACHLOROPHENE	70-30-4
HEXACHLOROPROPENE	1888-71-7
2-HEXANONE	591-78-6

CATEGORY OF ANALYSIS: APPENDIX IX (cont.)	
CONSTITUENT NAME	CAS NUMBER
HXCD0	
HXCDF	
INDENO(1,2,3-CD)PYRENE	193-39-5
IODOMETHANE	74-88-4
ISOBUTANOL	78-83-1
ISODRIN	465-73-6
ISOPHORONE	78-59-1
ISOSAFROLE	120-58-1
KEPONE	143-50-0
LEAD	7439-92-1
MERCURY	7439-97-6
METHACRYLONITRILE	126-98-7
METHAPYRILENE	91-80-5
METHOXYCHLOR	72-43-5
3-METHYLCHOLANTHRENE	56-49-5
METHYLENE CHLORIDE	75-09-2
METHYL METHACRYLATE	80-62-6
METHYL METHANESULFONATE	66-27-3
2-METHYLNAPHTHALENE	91-57-6
METHYL PARATHION	298-00-0
4-METHYL-2-PENTANONE	108-10-1
2-METHYLPHENOL	95-48-7
3-METHYLPHENOL	108-39-4
4-METHYLPHENOL	106-44-5
NAPHTHALENE	91-20-3
1,4-NAPHTHOQUINONE	130-15-4
1-NAPHTHYLAMINE	134-32-7
2-NAPHTHYLAMINE	91-59-8
NICKEL	7440-02-0
2-NITROANILINE	88-74-4
3-NITROANILINE	99-09-2
4-NITROANILINE	100-01-6
NITROBENZENE	98-95-3
2-NITROPHENOL	88-75-5
4-NITROPHENOL	100-02-7
4-NITROQUINOLINE-N-OXIDE	56-57-5
N-NITROSO-DI-N-BUTYLAMINE	924-16-3
N-NITROSODIETHYLAMINE	55-18-5
N-NITROSODIMETHYLAMINE	62-75-9
N-NITROSODIPHENYLAMINE	86-30-6
N-NITROSO-DI-N-PROPYLAMINE	621-64-7
N-NITROSOMETHYLETHYLAMINE	10595-95-6

TABLE 4-1 Constituents Analyzed for Cranston Project Listed by Category of Analysis (cont.)

CATEGORY OF ANALYSIS: APPENDIX IX (cont.)

CONSTITUENT NAME	CAS NUMBER
N-NITROSOMORPHOLINE	59-89-2
N-NITROPIPERIDINE	100-75-4
N-NITROPYRROLIDINE	930-55-2
5-NITRO-O-TOLUIDINE	99-55-8
2,2'-OXYBIS(1-CHLOROPROPANE)	108-60-1
PCB-1016	12674-11-2
PCB-1221	11104-28-2
PCB-1232	11141-16-5
PCB-1242	53469-21-9
PCB-1248	12672-29-6
PCB-1254	11097-69-1
PCB-1260	11096-82-5
PECCD	
PECDF	
PENTACHLOROBENZENE	608-93-5
PENTACHLOROETHANE	76-01-7
PENTACHLORONITROBENZENE	82-68-8
PENTACHLOROPHENOL	87-86-5
PHENACETIN	62-44-2
PHENANTHRENE	85-01-8
PHENOL	108-95-2
P-PHENYLENEDIAMINE	106-50-3
PHORATE	298-02-2
2-PICOLINE	109-06-8
PRONAMIDE	23950-58-5
PROPANENITRILE	107-12-0
PYRENE	129-00-0
PYRIDINE	110-86-1
SAFROLE	94-59-7
SELENIUM	7782-49-2
SILVER	7440-22-4
STYRENE	100-42-5
SULFIDE	
SULFOTEPP	3689-24-5
2,4,5-T	93-76-5
2,3,7,8-TCDD	1746-01-6
TCDD	
TCDF	
1,2,4,5-TETRACHLOROBENZENE	95-94-3
1,1,1,2-TETRACHLOROETHANE	630-20-6
1,1,2,2-TETRACHLOROETHANE	79-34-5
TETRACHLOROETHENE	127-18-4

CATEGORY OF ANALYSIS: APPENDIX IX (cont.)

CONSTITUENT NAME	CAS NUMBER
2,3,4,6-TETRACHLOROPHENOL	58-90-2
THALLIUM	7440-28-0
THIONAZIN	297-97-2
TIN	SN
TOLUENE	108-88-3
O-TOLUIDINE	95-53-4
TOXAPHENE	8001-35-2
2,4,5-TP (SILVEX)	93-72-1
1,2,4-TRICHLOROBENZENE	120-82-1
1,1,1-TRICHLOROETHANE	71-55-6
1,1,2-TRICHLOROETHANE	79-00-5
TRICHLOROETHENE	79-01-6
TRICHLOROFLUOROMETHANE	75-69-4
2,4,5-TRICHLOROPHENOL	95-95-4
2,4,6-TRICHLOROPHENOL	88-06-2
1,2,3-TRICHLOROPROPANE	96-18-4
O,O,O-TRIETHYLPHOSPHOROTHIOATE	126-68-1
1,3,5-TRINITROBENZENE	99-35-4
VANADIUM	7440-62-2
VINYL ACETATE	108-05-4
VINYL CHLORIDE	75-01-4
O-XYLENE	
M&P-XYLENE	
ZINC	7440-66-6

CATEGORY OF ANALYSIS: ISOMERS OF DIOXINS AND FURANS THAT ARE NOT SPECIFIED IN THE APPENDIX IX LIST

2,3,7,8-TCDF	51207-31-9
1,2,3,7,8-PECCD	40321-76-4
1,2,3,7,8-PECDF	57117-41-6
2,3,4,7,8-PECDF	57117-31-4
1,2,3,4,7,8-HXCDD	39227-28-6
1,2,3,6,7,8-HXCDD	57653-85-7
1,2,3,7,8,9-HXCDD	19408-74-3
1,2,3,4,7,8-HXCDF	70648-26-9
1,2,3,6,7,8-HXCDF	57117-44-9
1,2,3,7,8,9-HXCDF	72918-21-9
2,3,4,6,7,8-HXCDF	60851-34-5

**TABLE 4-1 Constituents Analyzed for Cranston Project Listed by Category of Analysis (cont.)**

CATEGORY OF ANALYSIS: CRANSTON SITE-SPECIFIC

CONSTITUENT NAME	CAS NUMBER
BUTAZOLIDIN	50-33-9
DCDO	DCDO
DCDF	DCDF
IRGASAN DP-300	3380-34-5
PROPAMINE	139-40-2
TINUVIN 327	3864-99-1
TOFRANIL	113-52-0
TRCDO	TRCDO
TRCDF	TRCDF

CATEGORY OF ANALYSIS: CRANSTON SITE-SPECIFIC COMPOUNDS  
ADDED FOR PHASE II AFTER REVIEW OF PHASE I TENTATIVELY  
IDENTIFIED COMPOUNDS (TIC)

1,1-BIPHENYL  
2-CYCLOHEXENE-1-OL  
2-CYCLOHEXENE-1-ONE  
2,5-CYCLOHEXADIENE-1,4-DIONE  
DIMETHOXYACETOPHENONE  
METHYLBENZENE SULFONAMIDE  
n-OCTANE  
OXY-BIS(ETHANOL)

CATEGORY OF ANALYSIS: POTW/MPDES

CHEMICAL OXYGEN DEMAND  
HYDROCARBONS  
OIL AND GREASE  
TKN  
TOTAL DISSOLVED SOLIDS  
TOTAL ORGANIC CARBON  
TOTAL ORGANIC HALIDES  
TOTAL SUSPENDED SOLIDS

CATEGORY OF ANALYSIS: NUTRIENTS

AMMONIA AS N  
NITRATE-NITRITE AS N  
ORTHOPHOSPHATE

CATEGORY OF ANALYSIS: MAJOR/MINOR IONS

BIOLOGICAL OXYGEN DEMAND - 5	
CALCIUM	7440-70-2
CHLORIDE	
IRON	7439-89-6
MAGNESIUM	7439-95-4
MANGANESE	7439-96-5
POTASSIUM	7440-09-7
SODIUM	7440-23-5
SULFATE	

CATEGORY OF ANALYSIS: CORROSION/ENCRUSTATION

BICARBONATE ALKALINITY  
CARBONATE ALKALINITY  
SILICA, DISSOLVED  
TOTAL ALKALINITY

CATEGORY OF ANALYSIS: GEOTECHNICAL PARAMETERS

BULK DENSITY  
COMBUSTIBILITY (BTU VALUE)  
PARTICLE SIZE  
PERCENT MOISTURE  
TOTAL ORGANIC CARBON (TOC)

CATEGORY OF ANALYSIS: MISCELLANEOUS TESTS

CATION EXCHANGE CAPACITY (CEC)  
LANGLIER INDEX

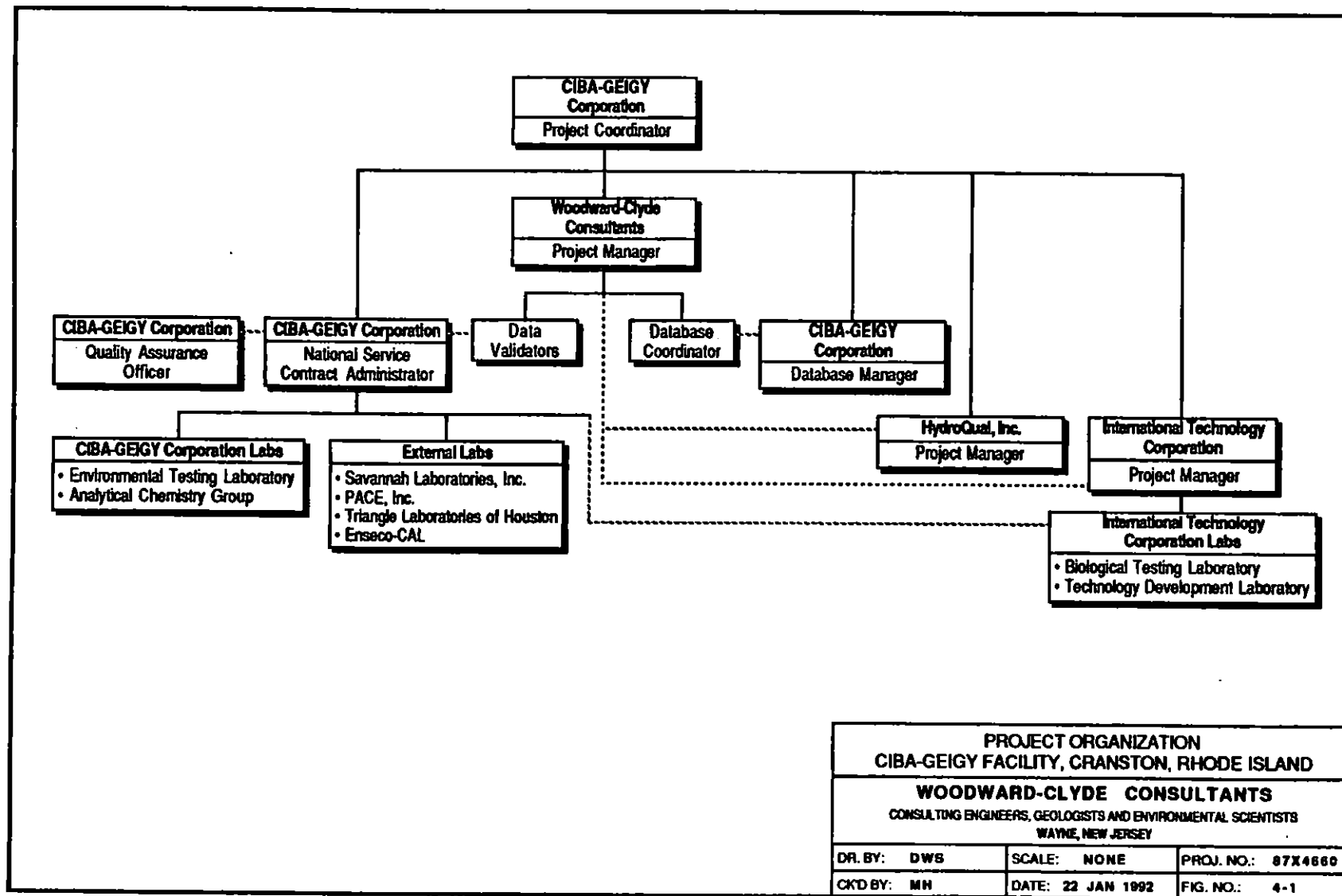


**TABLE 4-2 Identification and Status of Selected Vendors for Laboratory Analysis.**

DATA TYPE	PRIMARY LABORATORY	BACK-UP LABORATORY
Appendix IX (non-dioxin) plus the site-specific compounds	Savannah Laboratories, Inc.	PACE, Inc.
Appendix IX dioxins & furans	to be determined <sup>1</sup>	to be determined <sup>1</sup>
Water Quality Parameters:		
POTW/NPDES	CIBA-GEIGY Environmental Testing Lab <sup>2</sup>	Savannah Labora- tories, Inc.
Nutrients	CIBA-GEIGY Environmental Testing Lab	Savannah Labora- tories, Inc.
Major/Minor Ions	CIBA-GEIGY Environmental Testing Lab	Savannah Labora- tories, Inc.
Corrosion/En- crustation	Savannah Laboratories, Inc.	none
Bioassay and TIE	IT Corporation (Edison, NJ)	none
Geotechnical	IT Corporation (Oakridge, TN)	none
PCB Screening	CIBA-GEIGY Analytical Chemistry Group	none
Miscellaneous tests (CEC, Langlier Index)	Savannah Laboratories, Inc.	none

<sup>1</sup>Enseco-CAL and Triangle Labs of Houston are the two laboratories selected. The main responsibility for analyses is dependent upon timing of the fieldwork.

<sup>2</sup>Savannah Laboratories, Inc., analyzes Total Organic Halides (TOX)



## 5.0 QUALITY ASSURANCE OBJECTIVES

### 5.1 Overview

The quality assurance objectives for the project are that data be sufficiently complete, representative, comparable, accurate, precise, and sensitive enough (detection limits appropriate) to characterize the site, assess public health and environmental impacts, and evaluate remedial alternatives.

Quality Assurance elements which are addressed for all field and laboratory analysis include precision, accuracy, representativeness, completeness and comparability (PARCC parameters). Blank contamination, instrument calibration, sample holding times, sample preservation, and sample transport are other quality assurance elements that are important to the project. Each of these parameters are addressed from the perspective of the laboratory or technical consultant in their individual QA project plans contained in the appendices.

### 5.2 PARCC Parameters

The PARCC parameters needed to fulfill the objectives of the Consent Order may be more stringent or less restrictive than what is presented by each of the laboratories or technical consultants. In most cases, the objectives presented by the external vendors are what are *achievable* by the methods cited. In many cases, these achievable objectives are adopted by the project as a best case objective. It is likely that the normally achievable objectives cannot be obtained on the site-specific samples due to matrix interferences. During data validation, the normally achievable objectives are used as guidance and data falling outside the criteria specified in the Cranston-specific Data Validation Worksheets are qualified. Under most circumstances, it is not outliers from a single criterium that cause problems in data interpretation. Rather, it is the *combination* of non-attained objectives that form the difficulty in data interpreta-

tion. Therefore, it is the evaluation of the data by the external technical consultants that determines if the objectives of the Consent Order have been met. From a project perspective, the target objectives for the PARCC parameters are listed below.

**5.2.1 Precision** is an estimate of how reproducible a reported result is. It will be expressed in terms of Relative Percent Difference (RPD) which is the difference between two results that ideally would be identical. The field duplicates will be sent as single blind duplicates to the laboratories. The laboratories will know they are field duplicates, but they will not know which sample is being duplicated. The purpose of the field duplicates is to measure the *combined variability* for the field procedures and laboratory analysis. The *laboratory variability* will be evaluated using the RPD pairs from matrix spikes (MS/MSD) and laboratory control samples (LCS), (e.g., blank water spiked with compounds/analytes targeted for analysis). Table 5-1 lists the compounds/analytes that will be spiked into the MS/MSD and LCS that have acceptance limits specified in a USEPA Contract Lab Program (CLP) Statement of Work (SOW). The acceptance limits from the 3/90 SOW are the limits presented in Table 5-1, Table 5-3, and Table 5-4. For non-CLP compounds, the target project acceptance limits are presented in Table 5-2. These limits differ from the limits specified by Savannah Laboratories, Inc., and PACE, Inc., and are intended to present a reasonable compromise from a project perspective. The acceptance limits presented by the labs in their individual QA project plans for non-CLP compounds are based on control charts generated within each lab. The RPDs listed in Table 5-2 reflect the target limits for the *combined variability* from field procedures and laboratory analysis.

**TABLE 5-1** Target Percent Recovery (%R) and Relative Percent Difference (RPD) Limits<sup>1</sup> for Matrix Spike Samples and Laboratory Control Samples for Organic Methods.

	ACCURACY	PRECISION	ACCURACY	PRECISION
	WATER % RECOVERY	WATER % RPD	SOIL % RECOVERY	SOIL % RPD
<b><u>METHOD 8240</u></b>				
Benzene	76-127	11	66-142	21
Chlorobenzene	75-130	13	60-133	21
1,1-Dichloroethene	61-145	14	59-172	22
Toluene	76-125	13	59-139	21
Trichloroethene	71-120	14	62-137	24
<b><u>METHOD 8270</u></b>				
Acenaphthylene	46-118	31	31-137	39
4-Chloro-3-methylphenol	23-97	42	26-103	33
2-Chlorophenol	27-123	40	25-102	50
1,4-Dichlorobenzene	36-97	28	28-104	27
2,4-Dinitrotoluene	24-96	38	28-89	47
4-Nitrophenol	10-80	50	11-114	50
N-Nitroso-di-n-propylamine	41-116	38	41-126	38
Pentachlorophenol	9-103	50	17-109	47
Phenol	12-110	42	26-90	35
Pyrene	26-127	31	35-142	36
1,2,4-Trichlorobenzene	39-98	28	38-107	23
<b><u>METHOD 8080</u></b>				
Aldrin	40-120	22	34-132	43

<sup>1</sup>Since these compounds/analytes are listed in an EPA Contract Laboratory Program (CLP) Statement of Work (SOW), the CLP (3/90) SOW limits have been adopted.

**TABLE 5-1 (cont.) Target Percent Recovery (%R) and Relative Percent Difference (RPD) Limits<sup>1</sup> for Matrix Spike Samples and Laboratory Control Samples for Organic Methods.**

	ACCURACY	PRECISION	ACCURACY	PRECISION
	WATER %RECOVERY	WATER % RPD	SOIL % RECOVERY	SOIL % RPD
<b><u>METHOD 8080</u>(cont.)</b>				
Dieldrin	52-126	18	31-134	38
4-4'-DDT	38-127	27	23-134	50
Endrin	56-121	21	42-139	45
gamma-BHC	56-123	15	46-127	50
Heptachlor	40-131	20	35-130	31

<sup>1</sup>Since these compounds/analytes are listed in an EPA Contract Laboratory Program (CLP) Statement of Work (SOW), the CLP (3/90) SOW limits have been adopted.

**TABLE 5-2** Target Percent Recovery (%R) and Relative Percent Difference (RPD) Limits for Matrix Spike Samples and Laboratory Control Samples for non-CLP Compounds and Analytes.

	ACCURACY	PRECISION	ACCURACY	PRECISION
	WATER %RECOVERY	WATER % RPD	SOIL % RECOVERY	SOIL % RPD
<b><u>METHOD 8140/8141</u></b>				
Disulfoton	20-140	50	20-140	50
Ethyl parathion	20-140	50	20-140	50
Sulfotep	20-140	50	20-140	50
<b><u>METHOD 8150/8151</u></b>				
2,4-D	40-140	50	40-140	50
2,4,5-T	40-140	50	40-140	50
2,4,5-TP	40-140	50	40-140	50
<b><u>METHOD 8270: SITE-SPECIFIC FINGERPRINT COMPOUNDS</u></b>				
Irgasan-DP-300	40-140	50	40-140	50
Tinuvin-327	40-140	50	40-140	50
Propazine	40-140	50	40-140	50
Tofranil	40-140	50	40-140	50
Butazolidin	40-140	50	40-140	50
<b><u>METHOD 9030</u></b>				
Total sulfide	50-150	50		

**TABLE 5-3** Target Percent Recovery (%R) and Relative Percent Difference (RPD) Limits<sup>1</sup> for Matrix Spike Samples for Inorganic Parameters.

	ACCURACY	PRECISION	ACCURACY	PRECISION
	WATER %RECOVERY	WATER % RPD	SOIL % RECOVERY	SOIL % RPD
<b><u>METHOD 6010</u></b>				
Antimony <sup>2</sup>	75-125	20	75-125	20
Barium	75-125	20	75-125	20
Beryllium	75-125	20	75-125	20
Cadmium	75-125	20	75-125	20
Chromium	75-125	20	75-125	20
Cobalt	75-125	20	75-125	20
Copper	75-125	20	75-125	20
Nickel	75-125	20	75-125	20
Silver	75-125	20	75-125	20
Tin <sup>3</sup>	75-125	20	75-125	20
Vanadium	75-125	20	75-125	20
Zinc	75-125	20	75-125	20
<b><u>METHOD 7041</u></b>				
Antimony <sup>4</sup>	75-125	20	75-125	20
<b><u>METHOD 7060</u></b>				
Arsenic	75-125	20	75-125	20
<b><u>METHOD 7421</u></b>				
Lead	75-125	20	75-125	20

<sup>1</sup>Since these compounds/analytes are listed in an USEPA Contract Laboratory Program (CLP) Statement of Work (SOW), the CLP (3/90) SOW limits have been adopted.

<sup>2</sup>Analyzed by Method 6010 by Savannah Labs

<sup>3</sup>Savannah Labs does not add tin to their matrix spike samples.

<sup>4</sup>Analyzed by Method 7041 by PACE



**TABLE 5-3 (cont.) Target Percent Recovery (%R) and Relative Percent Difference (RPD) Limits<sup>1</sup> for Matrix Spike Samples for Inorganic Parameters.**

	ACCURACY	PRECISION	ACCURACY	PRECISION
	WATER %RECOVERY	WATER % RPD	SOIL % RECOVERY	SOIL % RPD
<b><u>METHOD 7470/7471</u></b>				
Mercury	75-125	20	75-125	20
<b><u>METHOD 7740</u></b>				
Selenium	75-125	20	75-125	20
<b><u>METHOD 7841</u></b>				
Thallium	75-125	20	75-125	20
<b><u>METHOD 9012</u></b>				
Total cyanide	75-125	20		

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<sup>1</sup>Since these compounds/analytes are listed in an USEPA Contract Laboratory Program (CLP) Statement of Work (SOW), the CLP (3/90) SOW limits have been adopted.

**TABLE 5-4** Target Percent Recovery (%R) and Relative Percent Difference (RPD) Limits<sup>1</sup> for Matrix Spike Samples for Laboratory Control Samples (LCS) for Inorganic Parameters.

	ACCURACY	PRECISION	ACCURACY	PRECISION
	WATER %RECOVERY	WATER % RPD	SOIL % RECOVERY	SOIL % RPD
<b><u>METHOD 6010</u></b>				
Antimony <sup>2</sup>	80-120	20	80-120	20
Barium	80-120	20	80-120	20
Beryllium	80-120	20	80-120	20
Cadmium	80-120	20	80-120	20
Chromium	80-120	20	80-120	20
Cobalt	80-120	20	80-120	20
Copper	80-120	20	80-120	20
Nickel	80-120	20	80-120	20
Silver	80-120	20	80-120	20
Tin <sup>3</sup>	80-120	20	80-120	20
Vanadium	80-120	20	80-120	20
Zinc	80-120	20	80-120	20
<b><u>METHOD 7041</u></b>				
Antimony <sup>4</sup>	80-120	20	80-120	20
<b><u>METHOD 7060</u></b>				
Arsenic	80-120	20	80-120	20
<b><u>METHOD 7421</u></b>				
Lead	80-120	20	80-120	20

<sup>1</sup>Since these compounds/analytes are listed in an USEPA Contract Laboratory Program (CLP) Statement of Work (SOW), the CLP (3/90) SOW limits have been adopted.

<sup>2</sup>Analyzed by Method 6010 by Savannah Labs

<sup>3</sup>Savannah Labs does not add tin to their matrix spike samples.

<sup>4</sup>Analyzed by Method 7041 by PACE

**TABLE 5-4 (cont.) Target Percent Recovery (%R) and Relative Percent Difference (RPD) Limits<sup>1</sup> for Matrix Spike Samples for Laboratory Control Samples (LCS) for Inorganic Parameters.**

	ACCURACY	PRECISION	ACCURACY	PRECISION
	WATER %RECOVERY	WATER % RPD	SOIL % RECOVERY	SOIL % RPD
<b><u>METHOD 7470</u></b>				
Mercury <sup>2</sup>	80-120	20	80-120	20
<b><u>METHOD 7740</u></b>				
Selenium	80-120	20	80-120	20
<b><u>METHOD 7841</u></b>				
Thallium	80-120	20	80-120	20
<b><u>METHOD 9012</u></b>				
Total cyanide	80-120	20		

<sup>1</sup>Since these compounds/analytes are listed in an USEPA Contract Laboratory Program (CLP) Statement of Work (SOW), the CLP (3/90) SOW limits have been adopted.

<sup>2</sup>For soils, PACE uses Method 7471.

**TABLE 5-5 Target Accuracy Acceptance Limits for Percent Recovery of Surrogate Compounds.**

	<u>WATER</u> <u>% RECOVERY</u>	<u>SOIL</u> <u>% RECOVERY</u>
<b>CLP SURROGATE COMPOUNDS:</b>		
<b><u>METHOD 8080</u></b>		
Dibutylchloroendate	24-154	20-150
<b><u>METHOD 8240</u></b>		
4-Bromofluorobenzene	86-115	59-113
1,2-Dichloroethane-d4	76-114	70-121
Toluene-d8	88-110	84-138
<b><u>METHOD 8270</u></b>		
2-Fluorobiphenyl	43-116	30-115
2-Fluorophenol	21-110	25-121
Nitrobenzene-d5	35-114	23-120
Phenol-d5	10-110	24-113
p-Terphenol-d14	33-141	18-137
2,4,6-Tribromophenol	10-123	19-122
<b>NON-CLP SURROGATE COMPOUNDS:</b>		
<b><u>METHOD 8140/8141</u></b>		
Ronnel <sup>1</sup>	SLI 45-135	SLI 22-127
or		
Triphenylphosphate <sup>2</sup>	PACE 23-176	PACE 28-174
<b><u>METHOD 8150/8151</u></b>		
2,4-Dichlorophenyl-acetic acid	50-150	50-150

<sup>1</sup>Surrogate used by Savannah Labs

<sup>2</sup>Surrogate used by PACE, Inc.

**5.2.2 Accuracy** is an estimate of how closely a result matches the "true value." For this project, accuracy will be measured in terms of 1) laboratory Performance Evaluation (PE) samples which have statistically determined true values and acceptance limits; 2) surrogate recoveries in the methods for organic compounds, and 3) matrix spike (MS) samples. The specific types and frequencies of PE samples implemented by the labs are defined in each of their individual QA project plans (see Section 12 in their documents). The additional project PE samples for dioxin-furan analyses are dependent upon availability from USEPA Region I. Table 5-5 lists the target accuracy limits for the surrogate compounds for each of the methods for organic compounds.

**5.2.3 Representativeness** is a measure of how well the subsample characterizes the whole. In the field, the samplers will take precautions to obtain samples that represent the area being sampled (e.g., monitoring wells will be purged, and sampling equipment will be decontaminated prior to sampling). In the laboratories, the analysts are required to obtain a representative subsample from the sample container.

**5.2.4 Comparability** is a measure of how one data set compares to another. In general, standardized methods, reporting formats, and units of measure set the framework for comparability. For this project, the discussion of comparability of data requires several viewpoints. For the non-Appendix IX compounds/analytes, the discussion is straightforward since the methods and reporting units are standard. (For full discussion of these parameters, see the laboratory QA project plans which discuss the non-Appendix IX compounds/analytes.)

For the Appendix IX compounds, the following points are discussed:

- Comparison of Appendix IX list to list of analytes/compounds actually reported

- Comparison of Appendix IX recommended methods and Practical Quantitation Limits (PQL) to the historical data from Radian and to Savannah Laboratories, Inc. (SLI), and PACE, Inc.

#### 5.2.4.1 DIFFERENCES FROM THE APPENDIX IX LIST

(1) Radian, SLI, and PACE have all demonstrated that Hexachlorophene cannot be reliably quantitated since it is not stable. Hexachlorophene will not be reported.

(2) The Appendix IX list contains "Total Xylenes." Radian, SLI, and PACE quantitate and report data as o-xylene and m + p xylene. This partial separation is useful to the risk assessors.

(3) 1,3,5-Trinitrobenzene was analyzed as a Tentatively Identified Compound (TIC) by Radian but SLI has documented it is feasible to quantitate this compound. PACE has not completed their method validation for this compound to determine if it will be reported as a TIC or a target compound.

(4) The Appendix IX list only requires one dioxin isomer (2,3,7,8-TCDD) to be quantitated and reported separately from the "total" concentration of tetra through hexa congeners. Both Radian and Enseco-CAL analyzed samples during Phase IB using modified versions of Method 8280 to allow for quantitation of the other 2,3,7,8-chlorinated isomers. Due to the number and types of modifications to 8280 by both labs, comparability was not easily determined. To address this issue, the method proposed and accepted by USEPA Region I (beginning with the 9/91 groundwater sampling) is the CLP SOW (12/90) for Polychlorinated dibenzop-dioxins (PCDD) and Polychlorinated dibenzofurans (PCDF). This SOW specifies quantitation of all the 2,3,7,8-chlorinated isomers of dioxins and furans. The change in methods accomplishes two

goals: 1) to facilitate generation of interlaboratory data that is comparable (fewer, if any, modifications to the SOW are needed), and 2) to provide quantitative measurements for all the 2,3,7,8-chlorinated isomers to assist in the risk assessment. This change in methods may hinder comparability of new data with the historical data generated by Radian.

(5) Dinoseb has been documented by Radian and PACE to be unrecoverable in soil. Dinoseb will be reported for water samples only.

(6) Radian and PACE report 3-methylphenol and 4-methylphenol as separate compounds. SLI reports them as a combined total for 3 + 4 methylphenol.

#### 5.2.4.2 DIFFERENCES FROM THE APPENDIX IX RECOMMENDED METHODS AND PRACTICAL QUANTITATION LIMITS

Since SW-846 3rd edition methods allow some flexibility in associating compounds with methods, there is opportunity to generate confusion. In other words, the labs can analyze the same compound by different methods. For a limited number of compounds, there are differences in the methods selected by Radian, SLI, and Pace. In an attempt to keep the following comparisons straightforward, the recommended methods and PQLs in the Appendix IX list are used as the model. Differences from the recommended methods and PQLs are presented in Table 5-6 and Table 5-8 for SLI and in Table 5-7 and Table 5-9 for PACE. In order to maintain a sense of the historical data, the related information from Radian's QAPjP is also listed in Tables 5-6 and 5-7.

**5.2.5 Completeness** is a measure of the amount of valid data generated from a measurement system. It is usually expressed as a percentage of valid data obtained based on the total amount of data attempted. Although 100% valid data is the general goal for

this project, there are categories where the Consent Order objectives can be met with less than 100% completeness obtained. The "acceptable" amount of incompleteness depends on the amount of redundancy of samples from the area.

For samples obtained in new areas or in fringe areas, the project goal is 100%. This means that 1) resampling will be initiated if the samples from these areas arrive broken at the lab, and 2) the laboratory will attempt reanalysis immediately upon identifying any quality control criteria out of control for these samples. Due to the questionable past data for dioxins/furans, all samples for this analysis are being considered as first-time samples, so the completeness goal is 100% for dioxin/furan analysis.

For other samples 80% completeness may allow the project objectives to be met. The overall goal for these samples is to attempt >90% completeness.



**TABLE 5-6** List of Compounds/Analytes Analyzed by Savannah Laboratories, Inc. (SLI) using a Method which Differs from the Recommended Method in the Appendix IX List. All Units are ppb. (Note that the Practical Quantitation Limit [PQL] achieved by SLI using the alternate method is lower than the Appendix IX recommended PQL except for the four compounds noted.)

ANALYTE	APPENDIX IX RECOMMENDATION		RADIAN			SAVANNAH		
	METHOD	PQL	METHOD	WATER PQL	SOIL PQL	METHOD	WATER PQL	SOIL PQL
ACETONITRILE <sup>1</sup>	8015	100	8240	20	400	8240	1000	200
ARSENIC	6010	500	7060	4	400	7060	10	1000
CHLOROBENZILATE	8270	10	8270	10	330	8080	0.50	17
CYANIDE	9010	40	9012	10	500	9012	10	1000
1,4-DIOXANE	8015	150	8240	10000	10000	8270	10	330
DISULFOTON	8270	10	8140	2	200	8141	2	66
HEXACHLOROPHENE <sup>2</sup>	8270	10	8270	50	1700		N/A	N/A
ISOBUTANOL <sup>1</sup>	8015	50	8240	10000	10000	8240	1000	1000
ISODRIN	8270	10	8080	10	1600	8080	0.05	3.3
LEAD	6010	40	7421	3	300	7421	5	500
KEPONE	8270	10	8080	10	1600	8080	0.10	17
PENTACHLOROETHANE <sup>1</sup>	8270	10	8270	20	330	8240	25	25
SELENIUM	6010	750	7740	5	500	7740	10	1000
THALLIUM	6010	400	7871	5	500	7841	10	1000
TIN	7870	8000	6010	100	10	6010	50	5000

N/A = Not Analyzed

NOTE: The methods, water PQLs, and soil PQLs generated by Radian for Phase I of the project are presented above to facilitate comparison with the historical data.

<sup>1</sup>SLI PQL is higher than the Appendix IX recommended PQL.

<sup>2</sup>Hexachlorophene has been shown to be unstable. Although Radian stated the above PQLs in their QAPjP, they were not able to document that they could find it at any concentration. SLI states that they also are unable to reliably analyze for hexachlorophene.

**TABLE 5-7** List of Compounds/Analytes Analyzed by PACE, Inc., using a Method which Differs from the Recommended Method in the Appendix IX List. All units are ppb. Except for 1,4-Dioxane and Isobutanol, the PQLs achieved by PACE using the alternate method are lower than the Appendix IX recommended PQLs.

ANALYTE	APPENDIX IX RECOMMENDATION		RADIAN			PACE		
	METHOD	PQL	METHOD	WATER PQL	SOIL PQL	METHOD	WATER PQL	SOIL PQL
ACETONITRILE	8015	100	8240	20	400	8240	20	400
ANTIMONY	6010	300	7041	7	3000	7041	7	3000
ARSENIC	6010	500	7060	4	400	7060	4	200
CYANIDE	9010	40	9012	10	500	9012	10	10
DINOSEB	8270	10	8150	1	N/A	8150	1	N/A
1,4-DIOXANE	8015	150	8240	10000	10000	8240	500	2000
ISOBUTANOL	8015	50	8240	10000	10000	8240	1000	10000
ISODRIN	8270	10	8080	10	1600	8080	10	1600
KEPONE	8270	10	8080	10	1600	8080	10	1600
LEAD	6010	40	7421	3	300	7421	3	200
SELENIUM	6010	750	7740	5	500	7740	5	200
THALLIUM	6010	400	7871	5	500	7871	5	200
TIN	7870	8000	6010	100	10000	6010	100	10000

N/A = not analyzed

NOTE: The methods, water PQLs, and soil PQLs generated by Radian for Phase I of the project are presented above to facilitate comparison with the historical data.

**TABLE 5-8** List of Compounds that SLI reports a higher PQL than both the recommended Appendix IX PQL and the PQL generated historically for the project by Radian. All units are ppb.

ANALYTE	APPENDIX IX RECOMMENDATION		RADIAN			SAVANNAH LABS		
	METHOD	PQL	METHOD	WATER PQL	SOIL PQL	METHOD	WATER PQL	SOIL PQL
ACETONITRILE	8015	100	8240	20	400	8240	1000	200
ACROLEIN	8240	5	8240	75	1500	8240	100	200
ACRYLONITRILE	8240	5	8240	50	1000	8240	100	100
BERYLLIUM	6010	3	6010	2	200	6010	5	500
3,3'-DIMETHYLBENZIDINE	8270	10	8270	80	2700	8270	200	1700
DIMETHYLPHENETHYLAMINE	8270	10	8270	10	330	8270	2000	1700
DINOSEB <sup>1</sup>	8270	10	8150	1		8270	50	330
METHAPYRILENE	8270	10	8270	40	1300	8270	2000	3300
1-NAPHTHYLAMINE	8270	10	8270	20	660	8270	300	330
4-NITROQUINOLINE-N-OXIDE	8270	10	8270	100	3000	8270	100	3300
PENTACHLOROETHANE	8270	10	8270	20	330	8240	25	25
P-PHENYLENEDIAMINE	8270	10	8270	50	1700	8270	2000	1700
2-PICOLINE	8270	10	8270	70	2300	8270	200	330
PYRIDINE	8270	10	8270	20	660	8270	200	330
TOXAPHENE	8080	2	8080	1	160	8080	5	170
1,3,5-TRINITROBENZENE <sup>2</sup>	8270	10		N/A	N/A	8270	200	330
VINYL ACETATE	8240	5	8240	5	100	8240	10	10

N/A = Not Analyzed

NOTE: The methods, water PQLs, and soil PQLs generated by Radian for Phase I of the project are presented above to facilitate comparison with the historical data.

<sup>1</sup>Radian could not recover this compound from soil.

<sup>2</sup>Radian analyzed this compound as a Tentatively Identified Compound (TIC), but SLI has documented that they can reliably detect this compound.

**TABLE 5-9** List of Compounds that PACE reports a higher PQL than both the recommended Appendix IX PQL and the PQL generated historically for the project by Radian. All units are ppb.

ANALYTE	APPENDIX IX RECOMMENDATION		RADIAN			PACE		
	METHOD	PQL	METHOD	WATER PQL	SOIL PQL	METHOD	WATER PQL	SOIL PQL
ACETONITRILE	8015	100.	8240	20.	400.	8240	20.	400.
1,4-DIOXANE	8015	150.	8240	10000.	10000.	8240	500.	2000.
ISOBUTANOL	8015	50.	8240	10000.	10000.	8240	1000.	10000.
PENTACHLOROETHANE	8270	10.	8270	20.	330.	8270	20.	330.

## 6.0 SAMPLING PROCEDURES

Detailed information on sample locations, depth, type and number are provided in the Phase II Proposal (1991). Woodward-Clyde Consultants will be collecting all samples in accordance with the procedures described in their Quality Assurance Documents (March 1990) and in the attached supplement (Appendix B). The details of sampling for the environmental assessment, TIE, bioassay, and geotechnical parameters are contained in the QA project plan for IT Corporation (Appendices I and J). CIBA-GEIGY will notify the USEPA at least 14 days in advance of sample collection activities. If sampling activities are rescheduled, USEPA will be given at least 10 days advance notification.

If unforeseen circumstances necessitate major deviations from approved procedures, the USEPA Project Manager will be notified. Changes will be subject to USEPA verbal approval. All significant changes will be documented in the monthly reports to the USEPA Project Manager.

Throughout the Phase II investigation, CIBA-GEIGY will allow for split or duplicate samples to be collected by the USEPA and/or its authorized representatives. Sample bottles for split or duplicate samples will be provided by the USEPA. All sampling personnel (USEPA or its agents) are required to follow health and safety procedures such as those described in Volume 3 - Health and Safety Guidelines of the RCRA Facility Investigation Proposal (1990).

## 7.0 SAMPLE CUSTODY

Sample custody procedures will be applied to the project in two stages. The first stage involves the custody of samples in the field. Field sample custody procedures involve sample labeling, using chain of custody forms, sample packaging, and sample shipping procedures. These procedures are contained in the Woodward-Clyde Consultants QA documents provided in Appendix B.

The second stage involves the custody of samples in the laboratory. Laboratory custody starts with receipt of the samples and continues through sample storage, analysis, data reporting and data archiving. Sample custody protocols for each laboratory are described in their individual QA Project plans contained in Appendices C-I.

## **8.0 CALIBRATION PROCEDURES AND FREQUENCY**

Calibration procedures, including frequency of calibration, are provided for all field and laboratory instrumentation used during this project. Calibration procedures for field equipment used by Woodward-Clyde Consultants and IT Corporation are described in their QA Documents (Appendices B and I, respectively). Calibration procedures for instrumentation used by each laboratory are described in each laboratory's QA Project plan (Appendices C - J).

## 9.0 ANALYTICAL PROCEDURES

Quality Assurance is the responsibility of each analytical laboratory and technical consultant. Analytical methods and practical quantitation limits associated with the field and laboratory measurements to be performed during this study are provided in the individual QA project plans as outlined below:

<u>Compounds or Analytes</u>	<u>QA Project Plan</u>	<u>Appendix</u>
General field sampling and field methods	Woodward-Clyde Consultants	B
Appendix IX (non-dioxin) and CIBA-GEIGY Site-Specific Compounds	Savannah Laboratories, Inc.; PACE, Inc.	C, D
Appendix IX Dioxins/Furans	Triangle Labs of Houston, Enseco-CAL	E, F
POTW/NPDES <sup>1</sup>	CIBA-GEIGY ETL; Savannah Laboratories, Inc.	G, C
Nutrients	CIBA-GEIGY ETL; Savannah Laboratories, Inc.	G, C
Major/Minor Ions	CIBA-GEIGY ETL; Savannah Laboratories, Inc.	G, C
Corrosion/Encrustation	Savannah Laboratories, Inc.	C
PCB Screening	CIBA-GEIGY ETC Analytical Chemistry	H
Geotechnical Parameters	IT Corporation	J
Bioassay, TIE, and Biological Fieldwork	IT Corporation	I

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<sup>1</sup>Total Organic Halides is discussed only in the Savannah Laboratories, Inc. QA project plan.



## **10.0 DATA REDUCTION, VALIDATION AND REPORTING**

### **10.1 Overview**

The procedures and details of the reduction of data, verification of its validity and the reporting of data is contained in each of the QA Project Plans from the technical consultants and laboratories (See Appendices B-J). For several of the field tests and records, the information is maintained within the records kept at the technical consultant's files. The information is summarized and presented by the consultants to CIBA-GEIGY. The laboratories generate both paper and diskette versions of the data generated for Appendix IX, site-specific fingerprint compounds, and water quality parameters. The consultants and laboratories have full responsibility for the accuracy of the data they generate. The laboratory has responsibility to ensure that the paper and diskette versions of the data are identical. The processes used by each consultant and laboratory to ensure the accuracy of their information is verified through systems audits at the frequencies specified in Section 12 of this document and in Section 12 in each of the Appendices B-J. A data base is utilized to manage the data generated. It contains some field information generated by Woodward-Clyde consultants and the laboratory data generated for Appendix IX, site-specific fingerprint compounds and the water quality parameters. The remainder of this section describes the data management procedures used for this project.

### **10.2 Objectives of Data Management**

In general, the purpose of data management is to ensure that the data collected and used in this project are both complete and accurate. The objectives for data management on this project were outlined in the Consent Order and were described in Appendix B of the RCRA Facility Investigation Phase I Interim Report (November 1991). The information presented here contains a review of the current data base structure and management respon-

sibilities, therefore it reflects all changes to the system since the referenced document. It is beyond the scope of this document to define the details of all the changes made to the system. It is appropriate, however, to provide the following overview of the types of changes that have been made. In general, the data base was reviewed from several perspectives and the following changes were made to the system:

- the hardware has been changed to allow for more capacity;
- the responsibility for accurate queries has changed to minimize past problems;
- the definitions of the data qualifiers have been standardized for all the fields (raw data, validated data and final data);
- some fields which were not used have been deleted, and;
- the nomenclature for the compounds and analytes and the CAS numbers have been corrected and/or standardized.

To simplify the presentation of information, the following details are discussed in Appendix A:

- the hardware used for data management;
- the software used for data management, and;
- the structures of the record layouts for the laboratory diskettes

The types of data, the flow of information, the internal controls and the responsibilities are discussed in detail here. For the project, there are two main categories of data:

- data in the project data base, and
- data not in the project data base.

### 10.3 Data Not Maintained in the Project Data Base

The technical consultants are responsible for maintaining data generated by them and presented to CIBA-GEIGY in summary form. Some of the laboratory data is not added to the project data base (e.g., bioassay, TIE, PCB screening, geotechnical). For this type of data, the lab delivers the results to the

appropriate technical consultant in a report and the technical consultant is responsible for maintaining accurate summaries of the data.

#### **10.4 Data Maintained in the Project Data Base**

Field information is manually entered into the data base system by Woodward-Clyde Consultants staff. Woodward-Clyde Consultants has the responsibility for ensuring the accuracy of this information. Laboratory results for the Appendix IX list, the site-specific fingerprint compounds, and the treatability parameters are transmitted on diskette to CIBA-GEIGY for subsequent loading into the data base, and in paper reports to Woodward-Clyde Consultants.

##### **10.4.1 Field Information in the Project Data Base**

Woodward-Clyde Consultants staff manually enter field information into the data base **Sample Collection Table**. Some of the information associates the sample collection point to the appropriate site-specific categories (e.g., SWMU, area, subarea, location). Other information includes sample medium (e.g., soil, groundwater, surface water) and field notes (e.g., well purge volume). See Table 10-1 for the list of fields available for data from the field. There are several key fields from the **Sample Collection Table** that are populated from a table (LINK\_ID\_TABLE) which contains pre-entered geographical and medium information supplied by Woodward-Clyde Consultants. The LINK\_ID\_TABLE reduces the entry of redundant information for the samples.

##### **10.4.2 Laboratory Results in the Project Data Base**

For the Appendix IX list, the site-specific compounds and the treatability parameters, the results are reported by the labs on diskette. The diskette information contains results for the project compounds and analytes, results for Tentatively Identified Compounds (TICs), and quality control information (percent

recovery, relative percent difference, results for laboratory blanks). The three types of laboratory information are treated differently during the upload of the data into the data base and are stored in separate files, as described below. For the standard project compounds and analytes, the data are stored in the **Sample Analysis Table**. Table 10-2 lists the fields in the Sample Analysis Table. The description of the contents of key fields is discussed later in this section.

The TICs are compounds identified inconclusively (based on a computer library search) and for which no analytical standards for quantification were required in the Consent Order. Because TIC results have a lower level of confidence in the identification and reported concentration associated with them than the standard analytes, they are processed differently. During the load routine, TIC records are separated from the standard analyte records and are moved into an auxiliary set of tables which can be queried using SQL PLUS commands.

The quality control results are stored in an ASCII format file as an archive. Routine queries or review of the quality control information have not been developed.

**Table 10-1** Fields in the Sample Collection Table

<u>Field Name</u>	<u>Type</u>	<u>Width</u>	<u>Null?</u>
COMMENTS <sub>1</sub>	CHAR	240	
DATESTAMP	DATE		
LAB_ABBREV2	CHAR	10	NOT NULL <sup>2</sup>
LAB_REPORT_NUMBER	CHAR	15	
PHASE	CHAR	3	
PRIOR_RAINFALL	NUMB		
PRIOR_RAINFALL_UOM	CHAR	10	
RC_CUSTOMER_SAMPLE_ID	CHAR	26	NOT NULL
RC_FRACTION_FLAG	CHAR	1	
RC_FRACTION_ID	CHAR	1	
RC_SAMPLE_NO	CHAR	2	NOT NULL
RC_WORK_ORDER_NO	CHAR	7	NOT NULL
ROUND	CHAR	3	
SAMPLE_DATE	DATE		
SAMPLE_DEPTH	NUMB		
SAMPLE_DEPTH_UOM	CHAR	10	
SAMPLE_EVENT_NO	CHAR	15	
SAMPLE_ID	NUMB		NOT NULL
SAMPLE_POINT	CHAR	10	
SAMPLE_PRESERVED_IND	CHAR	1	
SAMPLE_PRESV_METHOD	CHAR	10	
SAMPLE_TIME	CHAR	4	
SAMPLE_TYPE	CHAR	10	
SAMPLING_METHOD	CHAR	4	
SITE	CHAR	15	NOT NULL
SITE_DEFINED	CHAR	15	
TOC_TO_WATER	NUMB		
TOC_TO_WATER_UOM	CHAR	10	
VOLUME_PURGED	NUMB		
VOLUME_PURGED_UOM	CHAR	10	
WC_AREA	CHAR	5	
WC_LOCATION	CHAR	5	
WC_MEDIA	CHAR	5	
WC_SAMPLER_FIRST_NAME	CHAR	20	
WC_SAMPLER_LAST_NAME	CHAR	20	
WC_SAMPLER_MID_INIT	CHAR	1	
WC_SAMPLE_DESCR	CHAR	240	
WC_SAMPLE_ID	CHAR	26	
WC_SAMPLE_MEDIUM	CHAR	15	
WC_SAMPLE_NO	CHAR	6	
WC_SAMPLING_CONSULTANT	CHAR	10	
WC_SUB_AREA	CHAR	5	

**NOTES:**

1. Field names may not have spaces between words; the underscore ( ) satisfies this requirement for processing in the Oracle data base.
2. NOT NULL means the field may not be left blank.

**Table 10-2** Fields in the Sample Analysis Table

<u>Field Name</u>	<u>Type</u>	<u>Width</u>	<u>Null?</u>
ANAL_METHOD	CHAR	10	
CONSTITUENT_NAME	CHAR	80	NOT NULL
FINAL_DATA_LC	CHAR	1	
FINAL_DATESTAMP	DATE		
LOADSEQ	NUMB		
MOD_SOURCE	CHAR	15	
PRACT_QUANT_LIMIT	NUMB		
RC_ANAL_RESULT	NUMB		
RC_CONCENTRATION_FACTOR	NUMB	8,2	
RC_DATE_ANALYZED	DATE		
RC_RAW_DATA	NUMB	13,5	NOT NULL
RC_RESULT_FLAG	CHAR	2	
RC_RESULT_LC	CHAR	1	
RC_TEST_CODE	CHAR	5	
RESULT_QUALIFIER1	CHAR	2	
RESULT_QUALIFIER2	CHAR	2	
RESULT_QUALIFIER3	CHAR	2	
SAMPLE_ID	NUMB		NOT NULL
SITE	CHAR	15	NOT NULL
STANDARD_UOM	CHAR	10	
SUB_ID	NUMB		
UOM	CHAR	10	
VALUE_IN_STAND_UOM_1	NUMB		
VALUE_IN_STAND_UOM_2	NUMB		
VALUE_IN_STAND_UOM_3	NUMB		
VAL_DATA_LC	CHAR	1	
VAL_DATESTAMP	DATE		
WC_FINAL_DATA	NUMB	13,15	
WC_VALIDATED_DATA	NUMB	13,15	NOT NULL
METALS_IND	CHAR	1	
DATESTAMP	DATE		

**NOTES:**

1. Field names may not have spaces between words; the underscore ( ) satisfies this requirement for processing in the Oracle data base.
2. NOT NULL means the field may not be left blank.

#### **10.4.3 Validation of Key Fields During Data Upload**

This validation ensures that selected fields in data records contain only pre-approved entries. For example, a list of valid analyte (constituent) names is in the system; while loading the data (discussed later), the system validates (i.e., checks) the analyte names against the list of valid analyte names. Records containing analyte names which appear on the list of valid analyte names will be accepted by the system; records containing analyte names not on the list will not be accepted. Those rejected Results records will be set aside for further examination.

This validation is performed on many, but not all, fields. In general, it is performed on fields associated with sample collection and analysis. The following fields are validated: TEST CODE, QUALIFIER, CONSTITUENT NAME, and UNIT OF MEASURE. The following fields are not validated: WORK ORDER NUMBER, SAMPLE NUMBER, CAS NUMBER, FRACTION ID, ANAL\_RESULT, CONCENTRATION FACTOR, and all date fields.

#### **10.4.4 Raw, Validated, and Final Data**

The system software tracks three categories of fields from the Sample Analysis Table-- *Raw Data*, *Validated Data*, and *Final Data* fields. Each category has three fields: LEADING CHARACTER, RESULTS, and QUALIFIER. The LEADING CHARACTER field accepts either a "less than" or "greater than" sign (i.e., "<" or ">"), the RESULTS field accepts numbers, and the QUALIFIER field accepts characters. When a Results record is loaded into the system, the three Raw Data fields are populated with data from the record. The system allows the user to display all three sets of fields on a visual display terminal (VDT).

The menu-driven system loads the data received from the labs into the Raw Data fields and copies the data into the Validated Data fields. (See Section 11 for details of how the Qualifier field is copied.) The system will not allow any modifications or changes to the Raw Data fields once the load is completed.

Changes specified during data validation are entered (on-line via modem) in the Validated Data fields by Woodward-Clyde Consultants data entry personnel as instructed by the data validators. Generally, changes resulting from data validation are made in the RESULTS and QUALIFIER fields. The Final Data fields contain the data used for reports.

#### 10.5 Loading the Raw Data

Loading the raw data into the project data base begins by logging the diskettes manually into a diskette delivery log to ensure all data received is loaded into the system. Loading the raw data accomplishes several goals:

- screening the data records for proper structure and content;
- automatically validating selected fields against pre-approved entries;
- extracting selected records (quality control results) and archiving them in ASCII files; and
- extracting selected records (TICs) and storing them for subsequent queries.

The process of loading raw data from the laboratory into the project data base has seventeen steps. See Figure 10-1 for an overview of the data flow.

1. The FRACTION.PRN and RESULTS.PRN files are copied from diskette to the hard disk. (See Appendix A for the layout of these two files.)
2. The Fraction records are loaded into a temporary table for processing. (Temporary tables are established as an intermediate step between reading the ASCII files from the diskettes and populating the project data base tables using the Oracle® system.)
3. A summary of the Fraction load procedure into the temporary table is printed to document and track the number of records processed.



4. The Fraction records which did not load into the temporary table can be corrected<sup>1</sup> at this step with written authorization from the lab.
5. The Results records are loaded into a temporary table for processing.
6. A summary of the Results load procedure into the temporary table is printed to document and track the number of records processed.
7. The Results records which did not load into the temporary table can be corrected<sup>1</sup> at this step with written authorization from the lab.
8. The sample records for blanks, matrix spikes, and matrix spike duplicate samples are extracted and transferred into ASCII storage files.
9. Records for TICs are extracted and inserted into auxiliary TIC Fractions and TIC Results tables.
10. The Fraction and Results records are reviewed in the temporary tables.
11. The Fraction records are loaded into the system.
12. A summary of the Fraction load procedure into the system table is printed to document and track the number of records processed.
13. The Fraction records which did not load into the system table can be corrected<sup>1</sup> at this step with written authorization from the lab.
14. A Prevalidation of Results is performed which is essentially a "trial run" process that loads the data into the Sample Collection and Sample Analysis tables to determine if the actual loading process (Step 15) is likely to encounter errors.

---

<sup>1</sup> Minor errors in record format or duplicate records are examples of records which would be corrected with written authorization from the laboratory. Generally, corrected diskettes from the lab are requested so that manual corrections are eliminated. If corrected diskettes are required, all successfully loaded data for that diskette will be deleted from the system and loaded cleanly and completely from the corrected diskette.

15. The Results records are loaded into the system.
16. A summary of the Result load procedure into the system table is printed to document and track the number of records processed.
17. The Result records which did not load into the system table can be corrected<sup>1</sup> at this step with written authorization from the lab.

During loading, records may be accepted by the system and inserted into the data base, or may be diverted to the TIC tables, to storage files, or to rejection files. Storage and Reject records remain as ASCII files, but the TIC data are loaded into an Oracle® table and may be queried using SQL PLUS. After the filtering and validating by the load routine is complete, accepted records pass the "gate", and may be analyzed using the system or Oracle® data base tools.

The load routine automatically validates selected fields in the Fraction and Results records by checking values in those fields against pre-authorized values (e.g., constituent names, units of measure, test codes, qualifiers). Also, records are checked for duplication and compatibility problems which may affect the integrity of the data base. Step 14 pre-validates selected fields and identifies problems before the work order (group of Fraction and Results records) is committed to the full load process in Step 15. The user can, at this point, make limited corrections to problems identified, and help ensure that the final load step will succeed.

The time required to complete a load routine for a work order depends on 1) the number of records in the FRACTION.PRN and RESULTS.PRN files, 2) the processing speed of computer, 3) the number and type of errors found and 4) the number of records already residing in the data base. Typically, Steps 1 through 14

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<sup>1</sup>Minor errors in record format or duplicate records are examples of records which would be corrected with written authorization from the laboratory. Generally, corrected diskettes from the lab are requested so that manual corrections are eliminated. If corrected diskettes are required, all successfully loaded data for that diskette will be deleted from the system and loaded cleanly and completely from the corrected diskette.

take from half an hour to two hours to execute; Step 17 takes from one to four hours to execute. When the entire 17-step load routine is completed, the work order is said to be "loaded". The data have been inserted into the appropriate fields of either 1) Sample Collection and Sample Analysis tables in the system, 2) auxiliary TIC tables, or 3) storage or archival ASCII files.

#### 10.6 Validating the Data

The system automatically copies the values in the Raw Data fields into the Validated Data fields. Validating the raw data begins by producing a report of the just loaded data showing the raw data values and the data loaded into the validated fields. The data validators at Woodward Clyde Consultants use this system-generated report in conjunction with the hard copy of the data sent to them from the laboratory to assess the validity of the raw data. The procedure used by the data validators (See attachment 1 of Appendix B) results in changes to some data field values, usually to values in the RESULTS (i.e., concentration) and QUALIFIER fields.

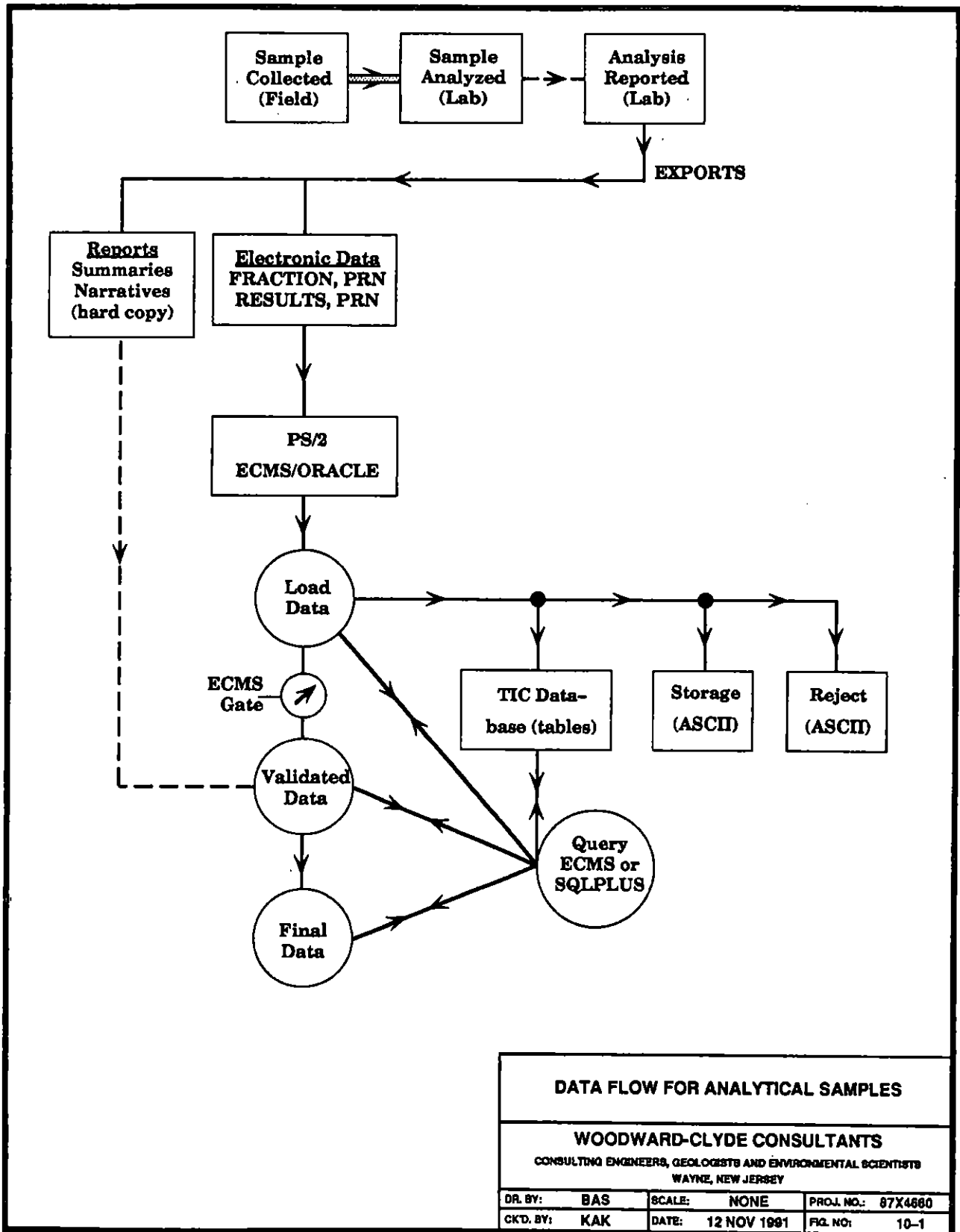
The changes are handwritten on hardcopy reports and passed to a keypunch operator at Woodward Clyde Consultants who enters the changes in the appropriate Validated Data fields in the project data base via modem. After changes are made to records in one work order, the keypunch operator prints a summary of all the changes made. This summary is returned to the data validator who verifies that the changes are correct. If necessary, a second round of entry and verification is performed. This process ensures that potential errors introduced by the keypunch operator are detected and eliminated before the changes from validation enter final processing. The printed summaries for all work orders are kept for future reference.

#### 10.7 Certifying Final Data

Certifying final data involves transferring data from the Validated Data fields to the Final Data fields. Data records

satisfying the transfer rules are transferred from the Validated Data to the Final Data fields. The Validated Data field is then "locked" to prevent further editing, and a datestamp is added to record the date of the transfer.

Data from any of the three sets of fields (Raw Data, Validated Data, and Final Data) may be queried at any time using either on-line prompts or SQL PLUS statements. Reports may be generated using SQL PLUS commands or by requesting other pre-formatted (and more detailed) reports.



## **11.0 INTERNAL QUALITY CONTROL**

### **11.1 Overview**

Internal quality control checks are used in the field, in laboratory analyses, and in data management.

### **11.2 Field Quality Control**

Field quality control includes sample documentation, field blanks, trip blanks, and replicate field measurements. Detailed information about these quality control checks are provided in the Woodward-Clyde Consultants' QA project plan (Appendix B) and in IT Corporation's QA project plan (Appendix I).

### **11.3 Laboratory Analysis Quality Control**

Laboratory analysis quality control may include matrix spike and duplicate matrix spike samples, reagent blank samples, surrogate spike samples, controlled preparation of standards, and instrument calibration. Detailed information about these quality control checks are provided in the individual laboratory QA project plans contained in Appendices C - I.

### **11.4 Data Management Quality Control**

Data management quality control includes:

- verification steps built into the data management software to prevent loading invalid data (described in Section 10);
- verifications performed once the data have been loaded into the data base to ensure that the paper reports and the diskettes contain identical information;
- verification steps to ensure that proper data validation qualifiers have been added to the data (See discussion below.); and,
- system security.

#### **11.4.1 System Security**

The data security procedures can be grouped into two categories-- those used to protect data against *system failure*, and those used to protect data against *unauthorized access*.

##### **11.4.1.1 System Failure Protection**

The procedures used to protect the project data against failure of the system (e.g., from a lightning strike or a hard disk crash) fall into two categories-- *power protection procedures* and *back-up procedures*.

- **Power Protection Procedures.** Surge suppression/line filtering equipment has been installed to protect the project data base.
- **Back-Up Procedures.** Back-ups of actively changing files are made daily by the person coordinating the changes to those files. In addition, back-ups of the entire project data base are performed weekly under the supervision of the project data manager.

##### **11.4.1.2 System Assess Protection**

The procedures used to protect the project data against unauthorized access fall into three categories-- *data center access*, *system access*, and *virus protection*.

- **Data Center Access.** The project data base resides on the project system housed at CIBA-GEIGY in Ardsley, New York. The following procedures are in place to restrict access to the data center itself. Access to the *site and building* is restricted -- a guard is stationed 24 hours a day, 7 days a week at the Site entrance gate. Building access requires a CIBA-GEIGY issued security card during off hours and during work hours is monitored by a receptionist. The office in which the system resides is locked during off hours.

- **System Access.** The following procedures were implemented to restrict access to the system on which the project data base resides:
  1. Access to the system requires a *login ID* code, and issuance of log-in IDs is restricted.
  2. Access to the system also requires a *password*. Passwords are unique to log-in IDs, so obtaining a log-in ID is not sufficient for gaining access to the system.
- **Virus Protection.** Two procedures are used to protect the project data base from viruses:
  1. Software (See Appendix A for dexcription.) is installed only by specified system administration personnel.
  2. Portions of the system are scanned for viruses periodically.

#### 11.4.2 Data Validation Controls

The data is validated by Woodward-Clyde Consultants staff (or external technical consultants, if needed) according the the validation worksheets contained in Attachment 1 to the Woodward-Clyde Consultants QA project plan (Appendix B). Many of the rules for adding qualifiers to the data are straightforward. The list of valid lab flags (based on the USEPA CLP SOWs) that are used in this system (See Table 11-1.) are the valid entries for the qualifiers for the raw data. The qualifier "J" is the most commonly added qualifer during validation. Certain lab flags (e.g., "\*", "JD", "M", "N") are consistantly translated to "J" by the validators according to the worksheet procedures. These consistant translations are automated during the upload of the data to minimize transcription errors during editing of the validated data. The qualifier for the validated data field can still be edited, yet the majority of straightforward changes are made automatically to assist the clerk typist. Table 11-2



defines the translation of the Raw Data qualifier field to the Validated Data qualifer field during the upload procedure.

The number of valid data qualifers listed in the validation worksheets is much reduced from the list of USEPA CLP SOW lab flags and Table 11-1. The lab flags are directly copied or translated to the validation worksheet qualifers. Some lab flags require a professional judgement or a determination of which of the flag combinations are appropriate to qualify the final data. Table 11-3 lists the valid entries for the following qualifier fields:

- the raw data from the lab;
- the temporary validation qualifier field;
- the validation qualifier field before "locking" to final data, and;
- the final data qualifier field.

**Table 11-1** Definitions of Data Qualifiers for All Qualifier Fields

<u>Qualifier</u>	<u>Description</u>
A	Org: TIC is a suspected aldol-condensation product
B	Ino: CLP result < CRDL but > IDL Org: Detected in blank
C	Org: For pesticides/PCBs, identification confirmed by GC/MS
D	Sample dilution was necessary for this analyte/compound
E	Ino: Result estimated due to interference (Must be explained in case narrative) Org: Result exceeds calibration range
F	Org: For dioxins/furans, estimated maximum concentration (possibility of a false positive or false negative)
G	Greater than (>) value reported
J	Estimated value
L	Not analyzed; data expected was lost
M	Ino: Outside duplicate injection precision control limits
N	Ino: Spiked sample recovery outside control limits
P	Org: For pesticides/PCBs, results >25% different between the two GC column results.
Q	Outside control limit
R	Unreliable - Compound may be present or absent
S	Ino: Determined by Method of Standard Addition (MSA)
T	Calculated value
U	Compound/analyte was analyzed for, but not detected
V	Org: Identification not confirmed; second column not requested
W	Ino: Post-digestion spike for AA outside control limits
X	As defined by lab in case narrative
Y	As defined by lab in case narrative
Z	As defined by lab in case narrative
*	Ino: Duplicate analysis outside control limits
+	Ino: Correlation coefficient for MSA outside control limits
JB	Combination J and B
JD	Combination J and D
BD	Combination B and D
N*	(Inorganic only) combination N and *
NE	(Inorganic only) combination N and E
UN	(Inorganic only) combination U and N
UW	(Inorganic only) combination U and W

**Table 11-2** Rules for Translating the Data Qualifiers During the Load Procedure From the Raw Data Qualifier Field to the Validated Data Qualifier Field.

Raw Data Qualifiers.....	Loaded as...	Validated Data Qualifiers
*		J
+		+
B		B
BD		BD
C		C
D		D
E		E
F		F
J		J
JB		JB
JD		J
L		L
M		J
N		J
N*		J
NE		J
P		J
Q		Q
S		S
U		U
UN		U
UW		U
V		V
W		J
X		X
Y		Y
Z		Z

**Table 11-3 Valid Data Qualifiers for the First Two Stages of Data Upload and Validator Editing**

Valid in raw data (from lab) <u>RQ1</u>	Valid after auto-translation (temporary) <u>RQ2</u>	Valid after validator editing is complete (final) <u>RQ2 &amp; RQ3</u>
null	null	null
A	B	F
B	C	J
C	D	L
D	E	Q
E	F	R
F	J	U
J	L	V
L	Q	
M	R	
N	S	
P	U	
Q	V	
S	X	
U	Y	
V	Z	
W	+	
X	JB	
Y	BD	
Z		
*		
+		
JB		
JD		
BD		
N*		
NE		
UN		
UW		

## **12.0 PERFORMANCE AND SYSTEM AUDITS**

### **12.1 Overview**

System audits are 1) qualitative evaluations to determine whether appropriate QA/QC procedures are in place to ensure that quality objectives are met and 2) verification that established procedures are followed. Performance audits are quantitative evaluations conducted to ensure that the data generated are accurate.

### **12.2 System Audits**

Essentially, a system audit was conducted as part of preparing this document. All individual QA project plans were reviewed by CIBA-GEIGY personnel to ensure that the plans met the overall project objectives. During periods of project activity, CIBA-GEIGY will perform additional system audits of the field activities, laboratories, validation process, and the data management system as outlined in Table 12-1.

Systems audits to be performed by Woodward-Clyde Consultants and by each laboratory are described in their respective QA project plans.

### **12.3 Performance Audits**

Woodward-Clyde Consultants and the laboratories will conduct performance audits as described in their respective QA project plans. In addition, USEPA will be asked to provide performance audit samples for laboratories performing dioxin/furan analyses.

**TABLE 12-1**      **System Audits for Cranston Project**

Type Audit	Auditor	Frequency	Acceptance Criteria
Field Activities	CIBA-GEIGY (Project Coordinator)	During major field activities	Compliance with WCC SOPs and QAPjP
Data base	CIBA-GEIGY (CIS & NSCA)	Prior to reporting data to EPA	100% accuracy of information
Validation Process	CIBA-GEIGY (CIS & NSCA)	After validation but before data becomes "final"	Compliance with validation worksheets
Analytical Laboratories	CIBA-GEIGY (NSCA & QAO)	Before or during major analytical work	Compliance with the QAPjP and lab SOPs

**NOTES:**

1. CIS = Corporate Information Service
2. NSCA = National Service Contract Administrator
3. QAO = Quality Assurance Officer

## **13.0 PREVENTIVE MAINTENANCE**

### **13.1 Overview**

Preventive maintenance tasks that will be performed to minimize down time of field instruments, sampling devices, and laboratory instrument, as well as schedules of major preventive maintenance tasks are provided in the individual QA project plans contained in the appendices.

### **13.2 Data Base Preventive Maintenance**

(Patty needs to describe preventive maintenance including anti-virus software)

#### **14.0 SPECIFIC PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, REPRESENTATIVENESS AND COMPLETENESS**

Woodward-Clyde Consultants, IT Corporation, and the analytical laboratories have provided the equations necessary to calculate precision, accuracy, representativeness, comparability, and completeness (PARCC parameters) for each major measurement parameter in their respective QA project plans. These individual QA documents also describe procedures to determine whether their stated quality assurance and quality control objectives have been met.

From a project perspective, the procedures to access whether the project objectives have been met are implemented by the consultants performing the data interpretation. Woodward-Clyde Consultants will evaluate if the extent and nature of contamination have been sufficiently defined. IT Corporation will perform the PHERE and, in doing so, will evaluate if the data are sufficient for the public health and environmental risk evaluation. In support of these consultants, the data for the Appendix IX and site-specific compounds will be validated according to the Revised Data Validation Worksheets (included in Appendix B). The data qualifiers added during validation (see Section 10 for discussion) will assist the consultants by identifying potentially unreliable data.

In the reports submitted to USEPA, the consultants will discuss the rationale for identifying data gaps, if present. In contrast, if the data are determined to be sufficient, then the discussion of how the data satisfies the project Consent Order will be presented.



## **15.0 PROCEDURES FOR CORRECTING DEFICIENCIES**

Corrective actions will be implemented if the results of a system audit or performance audit are unsatisfactory. It will be the responsibility of the entity audited to assess the effect of an unsatisfactory audit result on existing data and to implement an appropriate corrective action. All audit results and corrective actions taken will be documented and reported to the Woodward-Clyde Consultants Project Manager (for field work) and to the CIBA-GEIGY National Service Contract Administrator (for laboratory analyses). The WCC project manager or the CIBA-GEIGY NSCA will evaluate whether the corrective action is appropriate and will notify the CIBA-GEIGY Project Coordinator of significant issues. All issues which significantly impact the quality of work or the schedule will be communicated immediately to the CIBA-GEIGY Project Coordinator.

The auditing criteria and corrective action processes specific to Woodward-Clyde Consultants and the laboratories are described in their individual QA project plans provided as appendices.

## **16.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT**

### **16.1 Overview**

Any laboratory or field work deemed to be unsatisfactory by laboratory, technical consultant, or CIBA-GEIGY personnel will be documented and communicated to the project manager of the laboratory or the technical consultant. The project manager must assess the impact of the unsatisfactory work on past activities or existing data, and a corrective action plan must be developed and implemented. A report must be submitted to CIBA-GEIGY which documents the impact and the corrective actions taken.

All internal field and laboratory audit results will be communicated to the appropriate managers and CIBA-GEIGY as described in the individual QA project plans. Any issue which impacts the quality of data generated or impacts the schedule must be communicated to the CIBA-GEIGY project coordinator immediately.

### **16.2 Notification to EPA**

Issues identified which significantly affect the quality of the data generated or the schedule will be communicated to the USEPA project manager immediately following assessment. Results of system and performance audits will be provided to EPA in the monthly progress report, if appropriate.

### **16.3 Revisions to the Document**

Informational changes which do not affect the quality of the data generated (e.g., personnel names, phone numbers, etc.) will be reviewed and updated prior to new periods of field or analytical activity. Revised pages of the document will be issued to all document holders at that time.

Significant changes of this document, whether identified prior to or during periods of activity, will be subject to approval by the USEPA. Any proposed change will be documented on a form (see Figure 16-1) which includes the nature of the change,

the reason for the change, the ramifications of the change, and any actions that may be necessary to account for deficiencies produced by the change. The form will be authored by the entity who implemented or will implement the change and will be signed by both the responsible project manager and the CIBA-GEIGY project coordinator. The form will be submitted to the USEPA project manager for review and approval. Once the change form is approved by the USEPA, revised pages of the plan will be issued to all document holders.

**CRANSTON QAPjP TRACKING FORM**

PERSON REQUESTING REVISION: \_\_\_\_\_

Date request  
initiated: \_\_\_\_\_

RESPONSIBILITY OF REQUESTOR IN  
CRANSTON PROJECT: \_\_\_\_\_

NATURE OF CHANGE TO QAPjP:

Type: 1. Major \_\_\_\_\_ Minor \_\_\_\_\_ (check one)  
2. Informational \_\_\_\_\_ Technical \_\_\_\_\_ (check one)

Section(s): \_\_\_\_\_ of Document \_\_\_\_\_

REVISION: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

REASON FOR CHANGE: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

EFFECTS OF CHANGE: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

NECESSARY CORRECTIVE ACTION(S): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Project Manager  
Responsibility: \_\_\_\_\_

\_\_\_\_\_  
Date

\_\_\_\_\_  
CIBA-GEIGY Project Coordinator

\_\_\_\_\_  
Date

APPROVED (if technical change):

\_\_\_\_\_  
USEPA Project Manager

\_\_\_\_\_  
Date

**Figure 16-1** Revision to QAPjP Tracking Form

## 17.0 CURRENT PERSONNEL FOR KEY POSITIONS

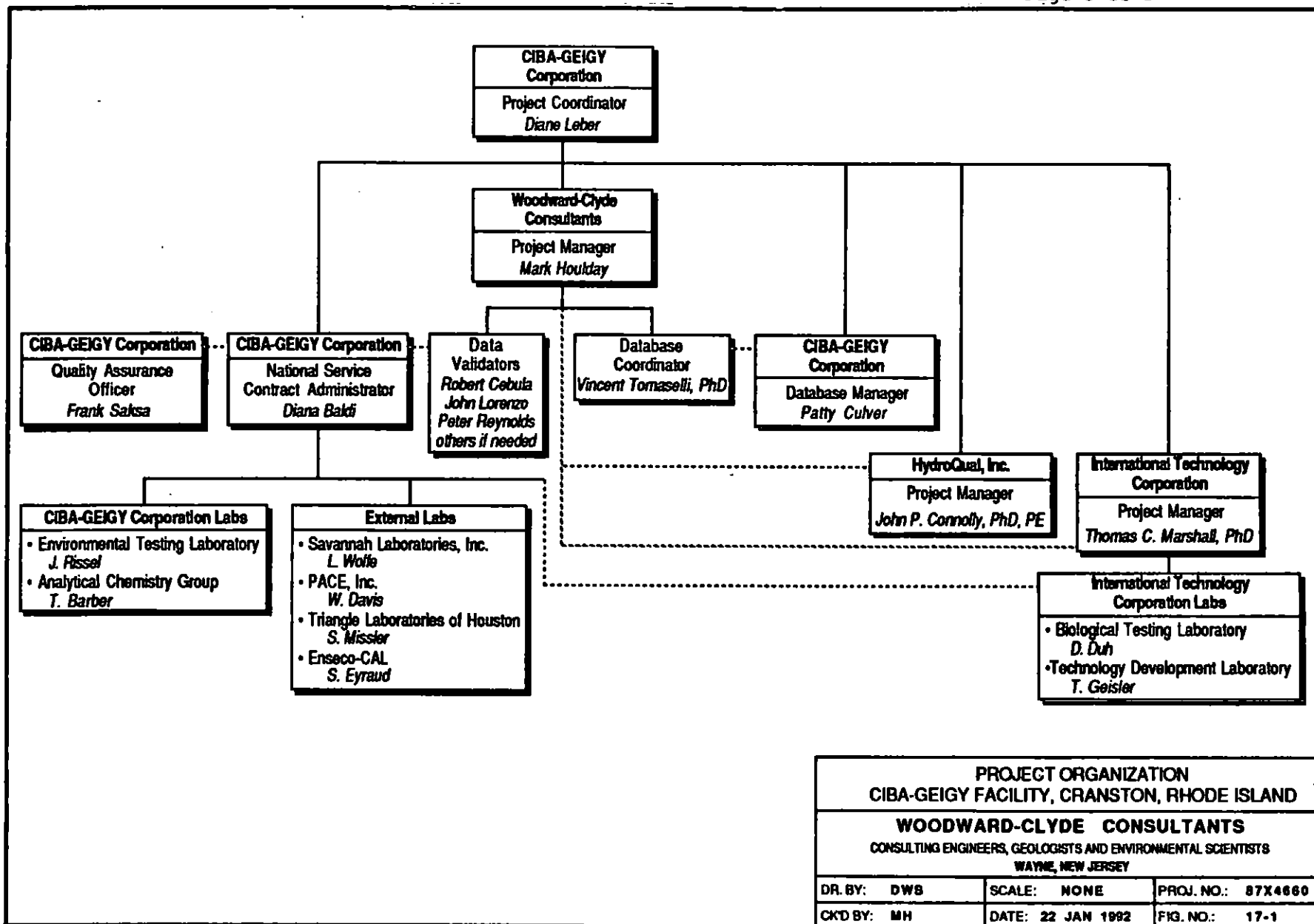
Table 17-1 lists the current personnel for key positions, and Figure 17-1 shows the organizational structure for the Cranston Project.

**TABLE 17-1** List of Current Personnel for Key Positions

AFFILIATION	TITLE	NAME	ADDRESS	TELEPHONE & FAX NO.
CIBA-GEIGY Corporation	Project Manager	Diane Leber	444 Saw Mill River Road Ardsley, NY 10502	(914)479-2159 FAX: (914)479-2332
CIBA-GEIGY Corporation	National Service Contract Administrator	Diana Baldi	410 Swing Road Greensboro, NC 27419	(919)632-7506 FAX: (919)632-2048
CIBA-GEIGY Corporation	Database Manager	Patty Culver	444 Saw Mill River Road Ardsley, NY 10502	(914)479-4365 FAX: (914)479-2290
CIBA-GEIGY Corporation	Quality Assurance Officer	Frank Saksa	Route 37 West Toms River, NJ 08754	(908)349-2789 FAX: (908)505-9195
CIBA-GEIGY Corporation	Lab Manager	John Rissel	Route 37 West Toms River, NJ 08754	(908)349-2262 FAX: (908)505-9195
CIBA-GEIGY Corporation	Group Leader	Tom Barber	410 Swing Road Greensboro, NC 27419	(919)632-7297 FAX: (919)632-2048

TABLE 17-1 (cont.) List of Current Personnel for Key Positions

AFFILIATION	TITLE	NAME	ADDRESS	TELEPHONE & FAX NO.
Woodward-Clyde Consultants	Project Manager	Mark Houlday	201 Willowbrook Blvd. Wayne, NJ 07470	(201)785-0700 FAX: (201)785-0023
HydroQual, Inc.		John Connolly	1 Lethbridge Plaza Mahwah, NJ 07430	(201)529-5151 FAX: (201)529-5728
IT Corporation	Project Manager	Thomas Marshall	312 Directors Drive Knoxville, TN 37923	(615)690-3211 FAX: (615)690-3626
IT Corporation	Lab Manager	Tom Geisler	1570 Bear Creek Road Kingston, TN 37763	(615)482-6497 FAX: (615)482-1890
IT Corporation	Lab Manager	Dan Duh	165 Fieldcrest Avenue Edison, NJ 08837	(908)225-2000 FAX: (908)225-1691
Savannah Labora- tories, Inc.	Project Manager	Linda Wolfe	5102 La Roche Avenue Savannah, GA 31404	(912)354-7858 FAX: (912)352-0165
PACE, Inc.	Project Manager	Bill Davis	Robinson Lane, RD6 Wappingers Falls, NY 12590	(914)227-2811 FAX: (914)227-6134
Enseco-CAL	Project Manager	Shelly Eyraud	2544 Industrial Blvd. West Sacramento, CA 95691	(916)372-1393 FAX: (916)372-1059
Triangle Labs of Houston	Project Manager	Steve Missler	12823 Park One Drive Sugarland, TX 77478	(713)240-5330 FAX: (713)240-5341



**18.0        LIST OF CHANGES TO THIS QUALITY ASSURANCE DOCUMENT:  
             SUPPLEMENT #1**

Copies of approved QAPjP Tracking Forms (Figure 16-1) for this document, including all appendices, will be inserted into this section. The details of the changes will be added to the Section 18 of the document or appendix that is actually modified.





## **APPENDICES**

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- A — CIBA-GEIGY Corporation Database Management Plan
- B — Woodward-Clyde Consultants Data Collection Quality Assurance Documents
- C — Savannah Laboratories, Inc. Quality Assurance Documents
- D — PACE, Inc. Quality Assurance Documents
- E — Triangle Laboratories of Houston Quality Assurance Documents
- F — Enseco-CAL Quality Assurance Documents
- G — CIBA-GEIGY Corporation Environmental Testing Laboratory (ETL) Quality Assurance Documents
- H — CIBA-GEIGY Corporation Analytical Chemistry Group Quality Assurance Documents
- I — International Technology Corporation Quality Assurance Documents for Biological Analyses
- J — International Technology Corporation Quality Assurance Documents for Geotechnical Analyses



## APPENDICES

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- A — CIBA-GEIGY Corporation Database Management Plan
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- I — International Technology Corporation Quality Assurance Documents for Biological Analyses
- J — International Technology Corporation Quality Assurance Documents for Geotechnical Analyses

## APPENDIX A      DETAILS FOR PROJECT DATA BASE

### **A.1    Hardware**

The hardware used for data management on this project can be divided into two general categories-- *computing* hardware and *peripheral* (non-computing) hardware. The specific hardware used in each of these categories is discussed in this section.

#### **A.1.1    Computing Hardware**

The data is processed and managed using an IBM PS/2® Model 70 personal computer which resides at CIBA-GEIGY in Ardsley, New York. The PS/2 runs at a clock speed of 25 megahertz under Version 4.00 of the MS/DOS® operating system; it has a 4-megabyte (MB) random access memory (RAM), a built-in 120-MB hard disk drive, and one built-in 3.5-inch high-density (1.44 MB) diskette (floppy disk) drive. After validation is completed and the data has been moved to final data status, the database will be ported to a DEC VAX 8810 residing at CIBA-GEIGY in Ardsley, New York. Due to storage and speed constraints of personal computing and the massive amount of data for this project, it has become necessary to port the finalized data to a larger, faster and more secure platform.

#### **A.1.2    Peripheral Hardware**

The associated (non-computing) hardware used for data management on this project includes a TECMAR tape back-up system, one modem with dedicated telephone line, and one IBM pro-printer.

**Tape Back-Up System.** The PS/2 is equipped with a TECMAR Tape Backup System® model QT-60E for back-up of data files.

**Modems (and Dedicated Lines).** For external communication, a Motorola UDS V.3225 Modem® (2400 baud rate) with a dedicated telephone line was installed.

**IBM Proprinter.** A dedicated IBM proprinter, used for low-quality printing of data base records, reports, and other text files, was installed.

## **A.2 Software**

The software used for data management on this project also can be divided into two general categories-- *general* ("off-the-shelf") software and *specialized* ("project-specific") software.

### **A.2.1 General Software**

The general, or "off-the-shelf", software used for data management on this project includes:

- the MS/DOS operating system;
- Oracle® relational data base management software (and associated SQL® PLUS software);
- text editing software;
- communications software; and
- anti-virus software.

These general software packages are described here.

**MS/DOS Operating System.** As mentioned, both the PS/2 run under Version 4.00 of the MS/DOS ("Microsoft Disk Operating System") operating system published by Microsoft, Inc. (Redmond, WA).

**Oracle® Relational Data Base Software.** Version 5.1 of the Oracle® relational data base management system (RDBMS), developed by the Oracle Corporation (Redwood Shores, CA), is used for most data storage, retrieval, and processing functions in the

project data base. The Oracle® system was chosen because of its wide use and general availability. In addition, the Oracle software provides easy portability of the project data base to other processing platforms. Oracle® 5.1 runs an enhanced version of the Structured Query Language (SQL)-- SQL PLUS. (SQL is a standard data base language that permits quasi-natural language queries of data fields and records.)

**Text Editing Software.** The NORTON EDITOR has been installed as text editing software.

**Communications Software.** The project uses pcANYWHERE IV, published by Dynamic Microprocessor Associates (Huntington, NY), as communications software.

**Anti-Virus Software.** The Norton AntiVirus program has been installed to scan files for virus protection.

#### **A.2.2 Specialized Software**

This project uses a customized version of the Environmental Compliance Management System (ECMS) Remediation Module developed by Versar, Inc. (Columbia, MD) for environmental studies. All customization and changes to the ECMS system can only be done by authorized personnel employed by the vendor, Versar, Inc. The ECMS system is used as a pre-processor to Oracle and provides menu-driven loading, review, updating, and processing of data. In particular, the ECMS system allows the user to generate reports specified by querying the Oracle data base using SQL PLUS statements. The combination of the ECMS system and the Oracle data base software provides a means:

- for storing, retrieving and querying large amounts of data;
- for validating data in selected fields (once loaded into the data base); and

- of porting the data base to other computer systems.

The ECMS software was customized by Versar to accommodate the data structure used in this project.

### **A.3 Data Structure**

The structure of data records was specified to the analytical laboratory by CIBA-GEIGY. CIBA-GEIGY receives the analytical data from the laboratory on 3.5-inch high-density (1.44 MB) diskettes.

#### **A.3.1 File and Record Structures**

Each work order has two ASCII data files-- a FRACTION.PRN file and a RESULTS.PRN file. (PRN means "print.") Both files are needed to characterize and link all sample collection and analysis information for a particular sample. Each data file is composed of *records*; a typical data file may contain anywhere from 100 to 3500 records, depending on 1) the number of samples, 2) the sample medium of concern (i.e., soil, groundwater, surface water, or sediment), and 3) the analytes tested. Each record is divided into *fields* containing the analytical data and associated information.

#### **FRACTION.PRN Files and Fraction Records**

A FRACTION.PRN file contains Fraction records which describe sample collection information (such as the work order number, sample number, fraction ID, date collected, and date tested) (see Table A-1). Fraction records have six fields separated ("delimited") by commas. A typical Fraction record looks like this:



"9103170",01,"A","B-15A\*IB-2","03/14/91 09:35:00","S"

Additional details about the structure, field lengths and types, and format of Fraction records are provided in Table A-1.

#### RESULTS.PRN Files and Results Records

A RESULTS.PRN file contains Results records which describe sample analysis information such as constituent (analyte) name, concentration, unit of measure, and data qualifier (see Table A-2). Each Results record must correspond to one and only one Fraction record, but not vice versa-- in general, the number of Results records is much larger than the number of Fraction records. Results records have 12 fields delimited by commas. A typical Results record looks like this:

"9103170",01,"A","8240S","<",215,"J","71-43-  
2","Benzene","3/14/91",23.45,"ug/kg"

The WORK ORDER NUMBER, SAMPLE NUMBER, and FRACTION ID fields (the first three fields in above example) are part of each Results record, but the corresponding CUSTOMER SAMPLE ID field ("B-15A\*IB-2") found in a Fraction record is not part of a Results record. The following fields in Results records are of particular interest:

WORK ORDER NUMBER ("9103170"), SAMPLE NUMBER ("01"), and FRACTION ID ("A"). These three fields constitute a **laboratory process label** used to track and present analytical records. (This combination of fields is discussed in detail later.)

TEST CODE ("8240S"). This field identifies the analytical method used on the sample and the sample matrix. In this example, "8240" denotes the 8240 analysis for volatile organic compounds (VOCs), "S" indicates a "solid" sample matrix.

RESULTS ("215"). This field shows the concentration of the constituent (analyte) and requires an associated value in the UNIT OF MEASURE field.

QUALIFIER ("J"). This field shows one of a set of qualifiers for raw data (listed in Table B-3); "J" means the value in the RESULTS field has been estimated.

CAS NUMBER ("71-43-2"). This field shows the standardized CAS (Chemical Abstract Service) identification number for the analyte in the CONSTITUENT NAME field.

CONSTITUENT NAME ("Benzene"). This field shows the commonly accepted chemical name for the analyte-- that is, the common name of the chemical that was detected.

CONCENTRATION FACTOR ("23.45"). The value in this field is a detection limit multiplier used by the laboratory during analysis. The multiplier is based on dilutions of the sample extract (or digestate) and percent moisture for soil samples.

UNIT OF MEASURE ("ug/kg"). This field shows the unit in which the value in the RESULTS field is reported-- that is, the unit associated with the concentration detected; typical units reported by the laboratory are "mg/kg", "ng/g", "ug/L".

The ECMS system converts all laboratory-supplied units to one of three standard units of measure:

<u>Unit of Measure</u>	<u>Abbreviation</u>	<u>Type of Sample/Analyte</u>
milligrams per kilogram	mg/kg	soil, sediment (both river and SWMU-10 pond)
milligrams per liter	mg/l	water quality parameters
micrograms per liter	ug/l	groundwater, surface water (both river and pond)

**Table A-1 Record Layout for FRACTION.PRN File for Data on Diskette**

Name	Columns for Null?	Type	Description	Table Validation	Fixed Layout
* WORK_ORDER_NO	NOT NULL	CHAR (7)	Lab assigned number corresponding to a group of samples.		1 - 7
* SAMPLE_NO	NOT NULL	CHAR (2)	Lab assigned number identifying the field sample.		8 - 9
* FRACTION_ID		CHAR (1)	Used to uniquely identify splits from a single sample.		10
CUSTOMER_SAMPLE_ID	NOT NULL	CHAR (26)	Field ID, entered by lab, provided by Woodward-Clyde from the field. (e.g., SF-A13-J40(S))		11 - 36
DATETIME_COLL		CHAR (17)	Sample date & time collection, entered by lab, provided by Woodward-Clyde from the field. (MM/DD/YY HH:MM:SS)		37 - 53
FRACTION_FLAG		CHAR (1)	Valid values are 'M' (matrix spike), 'B' (blank), 'S' (spike), 'D' (dup), 'E' (sample record for which there is a dup). Field is used to exclude M,S, or B values.		54

\* - The WORK\_ORDER\_NO, SAMPLE\_NUMBER and FRACTION\_ID constitute the key and form a unique index.

**Table A-2 Record Layout for RESULTS.PRN File for Data on Diskette**

Name	Null?	Type	Description	Table Validation	Columns for Fixed Layout
* WORK_ORDER_NO	NOT NULL	CHAR (7)	Lab assigned number corresponding to a group of samples.		1 - 7
* SAMPLE_NO	NOT NULL	CHAR (2)	Lab assigned number identifying the field sample.		8 - 9
* FRACTION_ID		CHAR (1)	Used to uniquely identify splits from a single sample.		10
TESTCODE		CHAR (5)	4 digit test method number and soil 'S' or water 'W' indicator (e.g. 8080W).		11 - 15
RESULT_LC		CHAR (1)	Generally Null or '<' denotes conc. < det. limit		16
ANAL_RESULT		CHAR (14)	8 whole numbers, 5 decimals. (99999999.99999) May be null. - No leading blanks or zeros.		17 - 30
RESULT_FLAG		CHAR (2)	Validated field.	RESULT_FLAG TABLE	31 - 32
CAS_NO		CHAR (12)	Left justified. No leading blanks or zeros. Properly formatted imbedded dashes.		33 - 44
* ANALYTE_NAME	NOT NULL	CHAR (80)	Validated field.	ANALYTE_NAME TABLE	45 - 124
DATE_ANAL		CHAR (8)	Date of analysis, provided by lab. (MM/DD/YY).		125 - 132
CONCENTRATION_FACTOR		CHAR(14)	8 whole numbers, 5 decimals. (99999999.99999) May be null - No padding with blanks or leading zeros.		133 - 146
UOM		CHAR (10)	Validated field.	UOM_TABLE	147 -156

\* - The WORK\_ORDER\_NO, SAMPLE\_NUMBER, ANALYTE\_NAME and FRACTION\_ID constitute the key and form a unique index.



## APPENDICES

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- B — Woodward-Clyde Consultants Data Collection Quality Assurance Documents
- C — Savannah Laboratories, Inc. Quality Assurance Documents
- D — PACE, Inc. Quality Assurance Documents
- E — Triangle Laboratories of Houston Quality Assurance Documents
- F — Enseco-CAL Quality Assurance Documents
- G — CIBA-GEIGY Corporation Environmental Testing Laboratory (ETL) Quality Assurance Documents
- H — CIBA-GEIGY Corporation Analytical Chemistry Group Quality Assurance Documents
- I — International Technology Corporation Quality Assurance Documents for Biological Analyses
- J — International Technology Corporation Quality Assurance Documents for Geotechnical Analyses

RCRA FACILITY INVESTIGATION  
CIBA-GEIGY FACILITY  
CRANSTON, RHODE ISLAND

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DATA COLLECTION QUALITY ASSURANCE PROJECT PLAN  
SUPPLEMENT

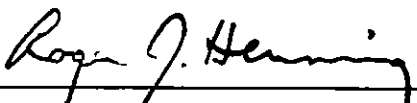
Submitted by:

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JANUARY 1992

  
\_\_\_\_\_  
Responsible Professional

  
\_\_\_\_\_  
Project Quality Assurance Officer



**LIST OF RECIPIENTS  
OF THE  
DATA COLLECTION QUALITY ASSURANCE PROJECT PLAN  
SUPPLEMENT  
JANUARY 1992**

**RCRA FACILITY INVESTIGATION  
CIBA-GEIGY FACILITY  
CRANSTON, RHODE ISLAND**

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Diane Leber ..... CIBA-GEIGY Project Coordinator

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Edward Hastings ..... WCC Quality Assurance Coordinator

Field Team ..... (12 copies with distribution controlled by  
the WCC QAC)

**RCRA FACILITY INVESTIGATION  
DATA COLLECTION QUALITY ASSURANCE PROJECT PLAN  
SUPPLEMENT**

**2.0  
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FACILITY CRANSTON, RHODE ISLAND

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EDITED FOR APPENDIX IX COMPOUNDS

3.0

PROJECT DESCRIPTION

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**PREFACE**

This document is a supplement to the approved Data Collection Quality Assurance Plan 31 March 1990 (hereafter 1990 DCQAP) which was prepared for the initial Phase I activities for the CIBA-GEIGY facility investigation.

This document is referred to as the DCQAP Supplement, and is intended to be used in conjunction with the 1990 DCQAP. Both documents are jointly referred to as the DCQAP.

The DCQAP Supplement contains modifications and additions to the 1990 DCQAP with the primary purpose to present new field and sampling procedures. Specific tasks which are planned for Phase II activities are presented in detail in the Phase II Proposal (November 1991).

**BACKGROUND**

The Alrose Chemical Company manufactured chemicals at the site starting in 1930; the GEIGY Chemical Company of New York purchased the facility in 1954 and merged with the Ciba Corporation in 1970. Thereafter, the facility was used for batch manufacturing of organic chemicals. Agricultural products, leather and textile auxiliaries, plastics additives, optical brighteners, pharmaceuticals, and bacteriostats have been manufactured at the facility. By May 1986, CIBA-GEIGY had ceased chemical manufacturing operations at the facility and had begun decommissioning and razing the plant.

A draft Administrative Order of Consent requiring a RCRA Corrective Action Study at the facility was issued to CIBA-GEIGY on 30 September 1988. After negotiations and evaluation of public comments, the Order was signed by CIBA-GEIGY on 9 June 1989



and became effective on 16 June 1989. This RCRA Corrective Action Study has four stages.

**Stage 1: RCRA Facility Assessment.** In 1987, EPA conducted the Facility Assessment to identify known and/or suspected releases at the facility requiring further action. The results were presented in the Final RFA Report, CIBA-GEIGY RCRA Facility Assessment (January 1988). In 1988, CIBA-GEIGY conducted a Preliminary Investigation (not required by the Order) to begin characterizing the facility's environment and selected releases; the results were summarized in the Current Assessment Summary Report (March 1990).

**Stage 2: RCRA Facility Investigation.** The Facility Investigation will characterize the impact of known and/or suspected releases that were determined by the Facility Assessment to require further action. The Facility Investigation is being conducted in two phases. The objectives of Phase I are to determine the nature of contamination associated with the facility and to conduct a preliminary evaluative of corrective measures that might be appropriate for remediating the contamination. CIBA-GEIGY proposed that Phase I be conducted in two parts (Phases IA and IB) to obtain additional guidance from USEPA throughout the project. Phase IA was conducted in late 1989 and mid-1990 to characterize the facility's physical environment more completely; the results of Phase IA were presented in the Phase IA Report (June 1991). Phase IB was conducted in late 1990 and early 1991 to characterize known and/or suspected releases at the facility more completely and to provide additional information about the facility's physical environment. The Phase I Interim Report presented the results of Phases IA and IB. Phase II will begin after EPA approves the Phase II Proposal and will entail additional site characterization and sampling, the risk assessment, and the Media Protection Standards (MPS) Proposal.

**Stage 3: CMS Proposal.** The Corrective Measures Study (CMS) Proposal describes the measures available for achieving the Media Protection Standards (MPS). Work on the CMS Proposal will begin after EPA approves the MPS Proposal.

**Stage 4: CMS Report.** The CMS Report evaluates the measures available to achieve the MPS at the facility. Work on the CMS Report will begin after EPA approves the CMS Proposal.

The site has three study areas - the Production, Warwick, and Waste Water Treatment areas. Twelve solid waste management units (SWMUs) and two areas of concern (AOCs) were identified at the site. For completeness, CIBA-GEIGY identified two additional areas of investigation (AAOIs).

## THE PHASE I INVESTIGATION

The Phase I *physical characterization* (geophysics, geology, hydrogeology, and hydrology) was conducted from mid-1990 to mid-1991 to investigate the site's subsurface conditions and environment, to fill data gaps remaining after the Preliminary Investigation of the facility, and to supplement existing information about the environmental setting of the site. The Phase I *release characterization* was conducted from late 1990 to mid-1991 to fill data gaps remaining after the Preliminary Investigation of the facility and to supplement existing information about the known and/or suspected releases at the site. The Phase I *off-site investigation* was conducted from early to mid-1991 to provide a better understanding of the off-site environment, to determine background characteristics of soils and groundwater, and to investigate conditions at off-site locations specified in the Order.

No additional media were identified as a result of Phase I; AAOI-16 has been designated as SWMU-16. No interim measures are recommended as a result of Phase I. Not all contaminants detected on-site are attributable to past facility releases. Because MPS have not been proposed, it is not possible to determine what areas might require corrective measures for specific media. In Phase II, additional data will be collected 1) to confirm the nature and determine the extent of contamination both on-site and off-site, 2) to collect any additional data needed to propose MPS, 3) to collect any additional data needed for the CMS Proposal, 4) to collect any additional data needed

for the Public Health and Environmental Risk Evaluation (PHERE), and 5) to refine the preliminary evaluative of corrective measures.

## THE PHASE II INVESTIGATION

The Phase II *physical characterization* will improve the understanding of the facility's physical environment and will include the Phase II geophysical, geological, hydrogeological, and hydrological investigations. The Phase II *release characterization* will provide a better understanding of the known and suspected releases at the facility and will include investigations in the Production Area, the Waste Water Treatment Area, the Warwick Area, and the Pawtuxet River. The Phase II *off-site investigation* will provide a better understanding of conditions surrounding the facility and will investigate soil and groundwater at background locations, as well as soil at fourteen off-site locations. Phase II is scheduled to be performed in about eleven months; field work will be completed in eight months. The investigation of the river will be on a separate schedule.

4.0

## PROJECT ORGANIZATION AND RESPONSIBILITY

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The project organization is shown on Figure 4-1. The project organization identifies the hierarchy and responsibilities of individuals involved in the project. The project organizational structure and personnel responsibilities are designed to provide adequate project coordination, control and proper quality assurance for the facility investigation.

The roles of key individuals were presented in the 1990 DCQAP. These roles and responsibilities will be essentially the same for Phase II activities. Two additional positions are being added to provide a primary contact for coordinating sampling activities with the field staff, site manager and laboratories and an on-site QA Coordinator. These positions are described below.

### Sampling Coordinator/Sample Custodian

The Sampling Coordinator (SC) reports to the Field Manager (FM) and has primary responsibilities for all aspects involving sampling and sample handling. Specifically, the SC will coordinate with the FM and sampling teams the actual sample collection requirements. The SC will also be responsible for scheduling sample container delivery, sample preparation and shipping samples to the laboratories.

### Quality Assurance Coordinator

The QA Coordinator reports to the QA Officer and has primary responsibilities for QA aspects of the field activities. The QA Coordinator will be the initial reviewer of field activities as they occur and will be responsible for ensuring that the activities are consistent with the QA documents.

5.0

**QUALITY ASSURANCE OBJECTIVE**

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Section 5.0 has no modifications for Phase II activities except completeness.

Completeness for the Phase II activities will be set at different levels for the known contamination zone and the fringe area or areas being sampled for the first time.

For samples collected within the known contamination zone, completeness will be set at 80%. Completeness for the fringe area samples, including dioxin samples, will be set at 100%. Corrective action will be initiated if data for any sample collected within this area is in non-conformance.

6.0

**SAMPLING PROCEDURES**

---

**6.1 OVERVIEW**

In addition to the sampling procedures presented in the 1990 DCQAP, selected new procedures will be used during Phase II activities. These procedures are presented and described in this section. Some procedures from the Phase I work have been modified and are also presented in this section. Proposed sample locations, depth, type and number are presented in Volume 2 Phase II Proposal (November 1991). Sampling procedures described below will be followed during Phase II activities of the Facility Investigation.

If unforeseen circumstances necessitate major deviations from the procedures described below, the USEPA Project Manager will be notified. Changes will be subject to USEPA approval and documented in writing (see Section 15.0).

Because of time constraints, all sampling events will be schedule driven, force majeure notwithstanding. CIBA-GEIGY will notify the USEPA at least 14 days in advance of all sample collection activities. If sampling activities are rescheduled, USEPA will be given at least 10 days advance notification.

Throughout the Facility Investigation, CIBA-GEIGY will allow for split or duplicate samples (of all media of concern) to be collected by the USEPA and/or its authorized representatives. Sample bottles for split or duplicate samples will be provided by the USEPA. All sampling personnel (USEPA or its agents) are required to follow health and safety procedures as described in the Project Health and Safety Plan.

## 6.2 SAMPLE COLLECTION TECHNIQUES

### 6.2.1 Boring Procedures

Geotechnical borings will be advanced to facilitate split-spoon sampling and to accommodate the installation of monitoring wells and/or piezometers. Twenty-two soil borings will be advanced during Phase II of the Facility Investigation to collect soil samples for visual classification and/or geotechnical analysis. All of these soil borings will be advanced to accommodate the installation of monitoring wells or piezometers. These wells will be located as shown on Figure 14-1 of Volume 2 Phase II Proposal (November 1991). Geological sampling associated with all of these borings is summarized in Table 14-3 of Volume 2 Phase II Proposal (November 1991).

Split-spoon samples provide information on the geologic conditions (stratigraphy) associated with the facility; installation of monitoring wells are necessary to obtain ground water samples and hydrologic information.

Borings will be advanced using power drilling systems such as truck or skid mounted rigs. Hollow stem augers will be used to advance boreholes in unconsolidated materials. Air or dual rotary methods will be used to advance boreholes in bedrock. Care will be exercised to reduce the potential for vertical cross contamination during drilling. If thick, and laterally continuous, low permeability units (i.e., clayey deposits) are encountered, then double casing drilling procedures will be employed. Determination of the need for double casing will be based on the professional judgement of the field inspector. The following procedures are applicable to hollow stem auger methods:

- Before beginning drilling activities the Site Manager or his/her designee will review the scope of work with the drilling contractor to ensure that proper equipment and materials are available, and that the field operations and health and safety requirements are understood.
- The location of underground and above ground utility lines will be determined before drilling begins.

- The field inspector will locate (with the assistance of a surveyor, if necessary) and mark each proposed boring location.
- A inspector will be on site during all drilling operations to inspect soil samples and to maintain an accurate geologic log for each boring (see Section 6.2.1.3). The inspector will be responsible for ensuring that the drilling performed by the contractor is in accordance with the work proposed herein. Other pertinent observations that may affect performance of the boring activities will be recorded in the field notebook (see Section 6.7) by the field inspector.
- All depths and lengths will be measured and recorded to the nearest 0.1 feet.
- Ambient air monitoring will be performed by the field inspector during drilling to characterize the air quality for health and safety purposes, and to identify potential emissions. Air monitoring instrument(s) and action levels based on air monitoring data are presented in Volume 4 Health and Safety Guidelines. Readings from the instrument will be recorded on boring logs by the inspector.
- Standard penetration tests will be performed, and split-spoon samples will be collected in accordance with ASTM-D-1586-84.
- Split-spoon samples will be collected continuously.
- Drilling equipment will be decontaminated before each boring as described in Section 6.8.
- Drilling spoils will be handled in accordance with the procedures described in Section 6.8.



**6.2.1.1 Split-Spoon Sampling Procedures.** Soil samples will be collected continuously from the borings advanced during Phase II of the Facility Investigation using split-spoon sampling techniques. Standard penetration tests will be performed and split-spoon samples will be collected in accordance with ASTM-D-1586-84. Split spoon samples are collected by driving (hammering) a hollow split tube sampler into the soil at the bottom of the borehole. A 140 lb. weight is dropped repeatedly over a vertical distance of 30 inches to drive the sampler, which is attached to drill rods. The number of blows from the weight or hammer required to advance the sampler 12 inches is recorded. These numbers (standard penetration) serve to help classify the soil. Generally, standard (2 feet long; 2 inch diameter) spoons will be used for sample collection. Larger diameter spoons (2 feet long; 3 inch diameter) may be used at selected sampling intervals. If recovery in a split-spoon is of insufficient quantity for analysis, then the material from above and/or below the intended sample horizon may be used to augment the sample volume. Such sample augmentation will be noted in the inspector's log book, when it occurs. The following procedures will be used during this investigation:

- Samples will be saved for classification in glass jars with screw-cap lids. Soil for this purpose may not be available after the other sample requirements (i.e., samples for chemical and geotechnical analysis) have been satisfied. If changes in soil type are observed within a single split-spoon sample, then representative subsamples from each soil type will be saved. All sample jars will be stored on site for the duration of the Facility Investigation.
- Soil samples will be classified in the field by the field inspector on site using the methods described in Section 6.2.1.2.
- Soil samples for laboratory chemical analysis will be transferred from the split-spoon sampler to the laboratory prepared sample containers using a stainless steel trowel which will be decontaminated before each use as described in Section 6.8.

- The split-spoon samplers will be decontaminated before collecting each sample for chemical analysis as described in Section 6.8.
- Samples for laboratory chemical analysis will be collected from the spoon (transferred) first, followed by samples for headspace analysis, followed by samples for geotechnical analysis.
- Headspace analysis of organic vapors within filled sample jars will be conducted in the field as described in Section 6.2.13.
- Selected soil samples from the borings may be analyzed for the physical parameters specified in Volume 2 - Phase II Proposal (November 1991). Those samples will be stored and transferred in appropriate containers supplied by the geotechnical laboratory.
- Test borings not intended for monitoring well installation will be backfilled with a cement/bentonite grout.
- Excess sample material will be handled in accordance with the procedure described in Section 6.8.

Although most of the subsurface soil samples will be collected using split-spoon sampling techniques, a limited number of samples may be collected with either a thin wall Shelby tube sampler or Denison tube sampler. Those samplers are designed to retrieve undisturbed samples suitable for laboratory permeability testing. Shelby and Denison tube samples will be collected in accordance with ASTM-D-1587-83. A thin wall (Shelby tube) sampler consists of a thin steel tube secured to a head containing a ball check valve. The head is threaded to connect to standard drill rods. The bottom of the tube has a sharp cutting edge. The sampler is pushed into the soil at the bottom of the borehole to impose minimal disturbance to the sample. Once removed, the ends of the tube will be sealed with wax to retain their moisture content and secured with a cap. The cap in turn will be secured with tape and waxed over. The tubes will be protected from extremes in temperature and physical disturbance at all times.

Where undisturbed samples are required in materials which cannot be penetrated by a Shelby tube, a Denison tube sampler will be used. Denison samplers operate on a principle similar to Shelby tubes except that the thin walled sampler remains stationary inside a rotating outer tube. The outer tube rotates while being forced downward to cut the sample free with minimum disturbance. The inner tube will be handled as described above for the Shelby tube samples.

**6.2.1.2      Soil Classification Procedures.** Soil descriptions will be based on observations of soil collected in the split-spoon sampler, soil cuttings (drilling spoils), or trimmings from tube samples. The description and classification of soil samples will be done by the field inspector during the drilling activities. Soil classification will be included on the boring logs (see Section 6.2.1.3).

The sequence of describing a soil sample will be as follows:

1.      Unified Soil Classification Symbol (ASTM D-2487-85);
2.      condition of soil, i.e. density or consistency;
3.      color;
4.      descriptive adjective for main soil component (i.e. fine, medium, coarse);
5.      main soil component (i.e. clay, silt, sand, gravel);
6.      descriptive adjective for minor soil component;
7.      minor soil component;
8.      miscellaneous descriptions;
9.      water content descriptive term (i.e. dry, moist, wet);

10. geological name, if known, or other names (in parentheses); and
11. other project specific classifications (i.e., sample number, duplicate sample designations).

**6.2.1.3      Boring Log Preparation Procedures.** A legible, concise, record of all significant information pertaining to drilling and sampling operations for each boring will be maintained concurrent with the advancement of the hole. That information will be recorded by the field inspector on the boring log. Required information on the boring log includes the following:

- classification and description of soil samples (see Section 6.2.1.2);
- classification and description of rock samples (see Section 6.2.2.1);
- depth or elevation of strata changes;
- depth or elevation of water table;
- number of blows per 6 inches of penetration of the split-spoon sampler during the standard penetration test;
- location and identification number of samples;
- depth and type of casing;
- sample recovery;
- characteristics of soil cuttings;
- real-time ambient air and sample organic vapor readings as measured on a flame ionization or photoionization detector (OVA or HNu);

- difficulties, if any, associated with drilling;
- date(s) of boring operations;
- headspace analysis results; and,
- name of person preparing the boring log.

Additional types of information other than those listed above will be recorded in the field notebook (see Section 6.7).

## **6.2.2 Rock Coring Procedures**

Wire line drilling equipment will be used to obtain rock core samples. Double tube wire line sampling allows the inner tube to be uncoupled and raised to the surface by means of a wire line passing through the drill rods. Two and one eighth inch diameter (NX) core will be obtained. Rock will be sampled continuously.

**6.2.2.1 Core Logging Procedures.** Observations made during core drilling will be recorded on the boring log by the inspector inspecting the operation.

### **Boring Log Rock Description**

A minimum of one complete rock description will be given per page. Otherwise, "As Above" with one or two modifications is acceptable.

Rock characteristics will be described in the following sequence, separated by semi-colons:

1. Rock type
2. Grain size
3. Grain shape (if applicable)

4. Mineral composition (if applicable)
5. Hardness
6. Strength
7. Degree of weathering
8. Stratification/Foliation (thickness and orientation)
9. Fracturing (spacing, orientation, coatings)
10. Stringers, veins, seams, vugs, and slickensides, where present
11. Color

The following criteria will be used to describe each characteristic:

1. Rock Type: determined by a inspector using experience and the additional criteria cited below; written in capitals.
2. Grain Size: determined by an inspector using experience and operational distinction.
  - (a) Very Coarse Grained: diameter greater than 0.2 in.
  - (b) Coarse Grained: Individual grains can be easily distinguished by eye.
  - (c) Medium Grained: Individual grains can be distinguished by eye.

- (d) Fine Grained: Individual grains can be distinguished by eye with difficulty.
- (e) Very Fine Grained: Individual grains cannot be distinguished by the unaided eye.

3. Grain Shape (if applicable)

- (a) Angular: showing very little evidence of wear. Grain edges and corners are sharp. Secondary corners are numerous and sharp.
- (b) Subangular: showing definite effects of wear. Grain edges and corners are slightly rounded off. Secondary corners are slightly less numerous and slightly less sharp than in angular grains.
- (c) Subrounded: showing considerable wear. Grain edges and corners are rounded to smooth curves. Secondary corners are reduced greatly in number and highly rounded.
- (d) Rounded: showing extreme wear. Grain edges and corners are smoothed off to broad curves. Secondary corners are few in number and rounded.
- (e) Well-rounded: completely worn. Grain edges or corners are not present. No secondary edges or corners are present.

4. Mineral Composition: identified by a inspector based on experience and the use of appropriate references. The most abundant mineral should be listed first, followed by minerals in decreasing order of abundance. For some common rock types mineral composition need not be specified (e.g. dolomite, limestone).

5. Hardness:

- (a) Soft: Reserved for plastic material alone.
- (b) Friable: Easily crumbled, pulverized or reduced to powder.
- (c) Low hardness: can be gouged deeply or carved with a pocket knife.
- (d) Moderately hard: can be readily scratched by a pocket knife; scratch leaves heavy trace of dust and is readily visible after the powder has been blown away.
- (e) Hard: can be scratched by a pocket knife with difficulty; scratch produces little powder and often is faintly visible.
- (f) Very hard: cannot be scratched with pocket knife.

6. Strength: subjective interpretation of the behavior of unfractured rock specimen when subjected to hammer blows. Excessive core breakage should be avoided.

- (a) Plastic: reserved for soils alone.
- (b) Friable: crumbles by rubbing with fingers.
- (c) Weak: crumbles under light hammer blows.
- (d) Moderately Strong: withstands a few firm blows before breaking.
- (e) Strong: withstands a few heavy hammer blows, but will yield large fragments.



- (f) Very Strong: resists heavy hammer blows and will yield with difficulty only dust and small flying fragments.

7. Degree of Weathering: the following table will be used to determine the degree of weathering.

**DEGREE OF WEATHERING  
DESCRIPTIVE TERMS**

<u>CRITERIA</u>	<u>DEEPLY(D)</u>	<u>MODERATELY(M)</u>	<u>SLIGHTLY(S)</u>	<u>FRESH(F)</u>
Physical Condition	Decomposed, friable to low hardness, friable to weak strength	Moderately decomposed, low to moderate hardness and weak to moderate strength	Slightly de-composed, moderately hard to hard, moderately strong to strong	Unaffected by weathering agents.
Minerals	Completely decomposed	Moderate decomposition; extensively stained (particularly iron-rich minerals)	Slight decomposition; some surficial staining	No decomposition of minerals.
Disintegration	Disintegrated	Most of the cement is moderately disintegrated	Slight to no effect	No disintegration
Rock Discoloration	Deep and thorough	Moderate or localized	Slight, Intermittent, or localized	No discoloration
Fractures	All are coated extensively with clay or silt, or stained with oxides or sulphides, or contain a carbonate or siliceous crust	+/-50% are coated with varying amounts of clay or silt, or stained with oxides or sulphides, or contain carbonate or siliceous crust	+/-10% are slightly stained	No alterations on fracture surface, no physical decomposition, usually very hard and very strong.

For most rock types, a sample can be considered deeply weathered when it can be broken between the fingers and fresh when it shows no staining or alteration at all.

8. Stratification/Foliation Thickness:

Stratum Thickness		Descriptive Term
3 ft	(1 m)	Very thick bedded
2 ft to 3 ft	(0.5 m to 1.0 m)	Thick bedded
2 in to 2 ft	(5 cm to 50 cm)	Thin bedded
0.5 in to 2.0 in	(1 cm to 5 cm)	Very thin bedded
0.1 in to 0.5 in	(2.5 mm to 10 mm)	Laminated
0.1 in	(2.5 mm)	Thinly laminated

9a. Fracture Spacing:

Spacing Between Fractures		Descriptive Term
≤0.5 in	(≤12 mm)	Crushed
0.5 in to 1.0 in	(12 mm to 25 mm)	Intensely
1.0 in to 6.0 in	(2.5 cm to 15 cm)	Closely
6.0 in to 1.0 ft	(15 cm to 30 cm)	Moderately
1.0 ft to 3.0 ft	(30 cm to 90 cm)	Slightly
3.0 ft	(90 cm)	Massive

9b. Fracture Coatings, Crusts and Staining may include:

Clay

Silt

Metallic oxides - generally iron or manganese oxide

Carbonates - such as calcite

Sulphates - such as gypsum

Sulphides - such as pyrite or marcasite

Silica - such as chalcedony or quartz

The extent and thickness of these features are described as follows:

Extent		Thickness	
Number of Fractures Area Covered	Descriptive Term	Thickness on Fracture Surfaces	Descriptive Term
10%	Some	<0.1 in (2mm)	Thin
10% to 50%	Moderate	± 0.1 in (2 mm to 3 mm)	Medium
50% to 100%	Extensive	>0.1 in (>3mm)	Thick

10. Stringers, Veins, Seams, Vugs, Slickensides, and other Features. Measure thickness and spacing, and determine orientation with a protractor or dipmeter on drill core. Mineral composition is determined by a inspector, based on experience and training.
11. Color. The Rock Color Chart distributed by the Geological Society of America will be used to describe the color of the rock when wet.

#### Core Boring Log Column Descriptions

- Recovery - The ratio of the length of core recovered to the total length of core drilled on a given run, expressed as a percentage and measured along centerline.
- RQD (Rock Quality Designation) - The ratio of the total length of core pieces 4 inches or longer to the total length drilled on a given run, recorded on the log as a percentage.
- Sketch - Fractures and layering will be sketched at the depth at which they are inferred to occur. Dip angles will be measured down from the horizontal.
- The remarks column on the log may be used for permeability test results, drilling rates, or other information as appropriate.

### **6.2.3 Test Pit Excavation Procedures**

Exploratory test pits will be excavated to evaluate the shallow subsurface material. Six test pits will be excavated in the area of SWMUs-2, -3, -7, -8, -10, and - II as shown on Figure 6- 1. Test pits will be dug using a backhoe. If ground water or a major obstacle are encountered at less than ten feet, the excavation will be terminated. If suspected contaminated materials are encountered during test pit excavation, a boring will be installed within five feet of the test pit to facilitate soil sampling. Every effort will be made to sample potentially contaminated materials. Procedures for advancing and sampling these borings will be the same as those described in Sections 6.2.1 and 6.2.1.1. Samples from the borings will be selected for chemical analysis based on visual evidence of contamination and/or results of field screening for organic vapors using a flame or photoionization detector. These samples will be analyzed for the parameters listed in Table 4-2 of Chapter 3, Section 4 of the RCRA Facility Investigation Proposal (1990).

The following general procedures will be used to excavate test pits.

- Before beginning field operations the Site Manager or his/her designee will review the scope of work with the excavation contractor to ensure that the proper equipment is available and that the field operations and health and safety requirements are understood.
- The location of underground and above ground utility lines will be determined before excavation begins.
- The field inspector will locate (with the assistance of a surveyor, if necessary) and mark each proposed test pit location.
- An inspector will be on site during all excavation operations to collect soil samples for visual analysis and field screening and to maintain an accurate log for each test pit. Samples will be collected at 1 foot depth intervals and screened for organic vapors using a photo - or flame ionization detector. The inspector will be responsible for ensuring that the excavation performed by

the contractor is in accordance with the work proposed herein. Other pertinent observations that may affect performance of the excavation activities will be recorded in the field notebook (see Section 6.7) by the field inspector.

- All depths and lengths will be measured and recorded to the nearest 0.1 feet.
- Ambient air monitoring will be performed using an HNu photoionization detector or an OVA flame ionization detector during excavation to characterize the air quality for health and safety purposes, and to identify potential emissions. Action levels based on air monitoring data are presented in Volume 3 - Health and Safety Guidelines. Readings from the instruments will be recorded in the test pit log by the field inspector.
- The inspector will describe any changes in lithology, color, or detectable odor of subsurface materials, and will note ground water level data on the test pit logs.
- Test pits will be backfilled upon completion. To the extent feasible, materials will be backfilled in the order in which they were excavated

6.2.3.1 **Soil Classification Procedures.** Soil descriptions will be based on observations by the field inspector of the in-situ material comprising the test pit walls and material retrieved with the backhoe. Procedures for classification and description of test pit soils will be the same as those described in Section 6.2.1.2.

6.2.3.2 **Test Pit Log Preparation Procedures.** A legible, concise, and complete record of all significant information pertaining to excavation and sampling operations for each test pit will be maintained by the field inspector concurrent with the excavation of the test pit. Required information on the test pit log will include the following:

- description of material encountered;

- depth or elevation of strata changes;
- real-time organic vapor readings as measured on a flame or photoionization detector (OVA or HNu);
- depth or elevation of water table;
- weather during test pit operations;
- date(s) of test pit operations; and
- name of person preparing test pit log.

Information regarding test pit operations, other than the types listed above, will be recorded in the field inspector's notebook (see Section 6.7).

#### **6.2.4 Surficial Soil Sampling**

Surficial soil samples (i.e., shallow samples not retrieved from boreholes) will be collected from 6-12 inches. Sampling locations and analyses are summarized in Tables 15-2 and 16-2 of Volume 2 Phase II Proposal (November 1991). Prior to sampling, the location will be cleaned of debris and vegetation. A steel spade will be used to dig a 4 to 6 inch diameter excavation at each sampling point. The samples will be scraped from the side wall of the excavation with a stainless steel trowel and transferred to the appropriate laboratory prepared sample containers. The spade and stainless steel trowels will be decontaminated prior to sampling each location in accordance with the procedures described in Section 6.8.

#### **6.2.5 Near-Surface Soil Samples**

Near-surface soil samples for chemical analysis will be collected from depths of 6-24 inches at the locations indicated in Volume 1 - Chapter 3 - Facility Investigation Work Plan. Samples will be collected at SWMU's -5, -6, -9, and -12. Depending upon the

subsurface geology, either small excavations (12 ft diameter) will be dug manually or a soil boring will be advanced using a hand auger. A decontaminated hand auger will be used to advance the boring to the desired depth. Once at the desired depth a second decontaminated auger will be used to retrieve the sample. If a hand auger is ineffective, a small excavation will be dug using a pick and shovel. Once the excavation is dug to the desired depth, soil samples will be retrieved following the methodologies described in the surficial soil sampling section. All sampling equipment will be decontaminated in accordance with procedures described in Section 6.8

#### 6.2.6 Point Piezometer Installation

Seven point piezometers will be installed at the facility to gain a better understanding of the hydraulics of ground water flow and will not be used for chemical analysis. Four piezometers will be installed in the Production Area, and three in the Pawtuxet River, the locations were shown in Figure 14-1 and 14-2, respectively, in Volume 2 - Phase II Proposal (November 1991). Depths of screened intervals for the proposed piezometers are summarized in Table 14.4 in Volume 2 - Phase II Proposal (November 1991). Piezometers will be installed in such a manner that precise water level measurements can be readily obtained. Both shallow and deep piezometers will be installed at selected locations to monitor discrete intervals within the overburden aquifer. Shallow piezometers will generally be installed 5 feet below the water table. Deep piezometers will be installed just above the confining layer (e.g. clay, till, rock) by one of several methods. In order of preference, these methods are:

- placed into an augered borehole and backfilled with a filter pack around the screened section, then tremie grouted to land surface;
- placed in a drilled borehole and finished as above;
- pushed or driven into place;
- placed into an augered borehole and driven the last 5 feet.

Selection of the installation method will be based on the professional judgment of the on-site inspector and will depend on the stratigraphy encountered and the availability of the equipment to emplace the piezometer tip. For instance, if gravel or boulders are encountered it may not be possible to drive the piezometer. In this case, it would be necessary to drill through the gravel or boulders.

Piezometers will be constructed of materials which are generally resistant to chemical and physical degradation. Point piezometers will consist of threaded 1-1/4 inch inside diameter riser pipes and screens. Riser pipes constructed of galvanized steel will be used exclusively. For the screened interval, three-foot, stainless steel, 7.5 slot screens will be used.

Piezometers pushed or driven into place will use an in-situ filter pack. For piezometers installed within drilled boreholes, a filter pack of either clean quartz sand, silica, or glass beads will be emplaced. For grouted installations, a cement/bentonite mixture will be tremied into the annular space above the filter pack.

A continuous pour concrete cap and well apron will extend below the frost line to protect the casing. The casing will be marked with identifying decals and surveyed. An incised arrow on the inside of the casing will be used to mark the surveyed reference point. A locking device will be installed to prevent unauthorized entry or vandalism of the well.

#### **6.2.7 Monitoring Well Installation Procedures**

Eighteen monitoring wells will be installed during Phase II of the Facility Investigation. Of these eighteen, six will be deep monitoring wells. Twelve wells will be shallow monitoring wells. The locations of wells to be installed are shown on Figure 14-1 of Volume 2 Phase II Proposal (November 1991). The proposed depth of the intake zone or screened interval for each of the wells is listed in Table 14-4 of Volume 2 Phase II Proposal (November 1991).



Monitoring wells will be installed in a manner such that representative ground water samples can be readily obtained. Contamination of this water-bearing zone during drilling and installation operations must be avoided. Vertical seepage of surface water to the monitoring well ground water intake zone along the borehole or well casing must also be minimized. Well installation materials must remain chemically inert with respect to the contaminants for the duration of the monitoring program.

#### Well Installation In Unconsolidated Materials

In accordance with the RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (1986), flush threaded 4-inch stainless steel well casing (including blank tail pieces will be used exclusively. For the screened interval, 4-inch stainless steel, continuous wire wound, 0.010 inch (No. 10) slot will be used. Based on our current understanding of subsurface site conditions, this slot size will be effective in prohibiting formational material from entering the well. In most monitoring wells, installation of screens 10 feet in length is anticipated. All well casings and screens will be steam cleaned prior to installation to ensure that remnant machine oils and greases have been removed.

Well casing and screen will be installed by suspending pipe no less than 1 foot above the bottom of the borehole and attaching additional lengths of threaded casing. A bottom cap will be installed at the base of the screen tail piece to prevent upward migration of ground water from below the well screen.

A primary filter pack of chemically inert clean quartz sand will be installed around the well screen. The primary filter pack will extend a minimum of 1 foot below and 2 feet above the screen. The primary pack will consist of No. 1 Morie sand. This sand consists predominantly of 0.04 inch grains which can easily be retained by No. 10 slot well screens. The secondary filter pack will extend a minimum of 1 foot above the primary pack and will consist of very fine sand of smaller diameter than the primary pack. Both chemically inert filter packs will be poured very slowly into the well bore or tremied if deemed appropriate by the field inspector.

An annular seal will be installed directly above the filter pack to prevent the vertical migration of contaminants to the sampling zone from the surface or intermediate zones. If hollow stem augers are used, the sealant will be installed between the casing and the inside of the augers. If other drilling methods are used (e.g. driving casing), the annular sealant will be tremied (installed through a pipe inserted in the annular space). In the saturated zone, sodium bentonite grit will be installed. In the vadose zone, an annular sealant of bentonite pellets will be slowly poured down the well bore and then tamped down to avoid bridging. The annular sealants will be a minimum of 2 feet in vertical thickness.

The annular space above the filter pack and seal will be grouted with a cement/bentonite mixture to minimize downward vertical migration of water to the ground water intake zone and to increase the integrity of the well casing. To ensure grout reaches the top of the annular sealant, it will be placed with a tremie pipe.

A continuous pour concrete cap and well apron will extend below the frost limit to protect the casing. The casing will be marked with identifying decals and surveyed. A locking device will be installed to prevent unauthorized entry or vandalism of the well.

### Bedrock Wells

Wells installed in bedrock will be constructed similarly to those in unconsolidated materials with the addition of a second casing or as openhole wells as described below. A 10-inch diameter hole will be drilled into the top of bedrock or, where bedrock is highly weathered, to a depth where split spoon samples do not penetrate. An 8-inch diameter steel casing will be grouted into the 10-inch hole using a cement/bentonite grout. Alternatively, where a tight fit can be obtained, 8 inch casing will be driven. After the grout has set, a 4-inch stainless steel well will be installed inside the casing as described above. The screen will be set 10 feet into the top of competent bedrock. Rock will be sampled from bedrock as described in Section 6.2.2.

If bedrock is found to be sufficiently competent and free of fines, openhole bedrock wells will be installed. These wells will be constructed by installing 6-inch stainless steel casing in the unconsolidated materials. Below these materials rock will be sampled as described in Section 6.2.2 and the resulting hole will be reamed using a tri-cone roller bit.

The field inspector inspecting well installation operations will complete an installation form for each well.

#### Recovery Wells

Recovery wells will be constructed similarly to monitoring wells in unconsolidated materials with the addition of performing grain size analysis in the field on soil samples.

A 10-inch cased hole using an air rotary technique will be used to install 6-inch diameter stainless steel screens and risers. The grain size of the aquifer sediments will be considered carefully in selecting the screen slot size. A 100-ml representative sample will be obtained and sieved by hand using a mechanical sieve analysis field kit.

After performing grain size analysis in the field on soil samples from P-32D and P-33D, the appropriate screen size(s) and length for the recovery wells will be ordered from the manufacturer. The length of the screen to be installed will be determined by headspace analysis of the split spoon samples, the screen will extend from the water table to 5-feet below the depth of probable contamination (as indicated from the headspace analysis). Solid and liquid spoils generated during drilling will be handled as described in Section 6.8.

#### River Wells

River wells will be constructed similarly to those in unconsolidated material with the exception of being constructed of 2-inch diameter stainless steel screens and risers. Drilling will be done with a drive wash technique (using 4-inch casing and a roller wash) or augers. Other drilling techniques may be used depending on conditions encountered in the field.

A trailer mounted drill rig and barge will be utilized to accomplish installation of three well clusters. Piezometers and monitoring wells will be installed as a 4-inch casing is pulled back from borehole. After the piezometer or monitoring well screen and riser has been set and the 4-inch casing is above the filter pack and bentonite seal, the annulus will be tremie grouted using a cement/bentonite grouted with the 4-inch casing left in place as a stickup protective casing in the river. The casings will be supported by the sampling platform and anchored to the bulkhead to protect the wells from debris during high-flow events. The casing will be marked with identifying decals and surveyed. Solid and liquid spoils generated during drilling will be handled as described in Section 6.8.

**6.2.7.1 Aquifer Testing Procedures.** All equipment which comes into contact with groundwater, such as water level measuring equipment, pumps, and delivery hoses or pipes will be decontaminated prior to and following installation in a well. Decontamination procedures are described in Section 6.8

#### Recovery Test

Recovery tests will be conducted on all newly installed monitoring wells and piezometers. This test begins by pumping a well, and then stopping the pump. When the pump is shut down, continuous water level measurements are recorded at time intervals shown below:

- 30 second intervals for first 5 minutes;
- 1 minute intervals for 10 minutes;
- 2 minute intervals for 20 minutes; and
- 5 minute intervals for the remainder of the test.

The frequency of readings will depend upon the geologic material being tested. In materials likely to have high hydraulic conductivity values, more frequent readings will be required. In material with anticipated low values, fewer readings within a time period would be acceptable.

The duration of the test will be controlled by the geologic nature of the materials being tested. Generally, the water level changes should be recorded until 80 to 90 percent of the initial static water level is recovered. At this time, the test can be terminated.

Conducting a water level recovery test permits calculating the transmissivity of the aquifer across the screened interval of the well. Transmissivity is the product of the hydraulic conductivity times the saturated length of the screened interval. Thus, calculating the transmissivity (of the screened interval) permits calculating the hydraulic conductivity (of the screened interval) because the saturated length of the screened interval is known.

#### Step-Drawdown Test

A step-drawdown test will be conducted on each of the two newly installed recovery wells. The step-drawdown test will be conducted in three or four steps of increasing discharge, each step lasting for 30 minutes. For each step, the discharge, water levels and time of measurement since commencement will be recorded. Water levels should be recorded at the following elapsed time in minutes from the commencement of each step:

- at 30 second intervals for the first 3 minutes;
- at 1 minute intervals from 3 minutes to 10 minutes; and
- at 5 minute intervals from 10 minutes to 30 minutes.

Following the last step of increasing of discharge the well will be allowed to recover. The duration of any test will be controlled by drawdown rates in the pumped well, water flows, and ability to store or dispose of discharged water.

During the course of a test, adjacent and nearby piezometers and wells will be monitored for water level changes. The following information will be recorded for all wells and piezometers monitored during the step-drawdown test:

- Name of well or piezometer;

- Elevation of casing survey mark;
- Well or piezometer diameter;
- Pump inlet depth below measuring point (pumped well);
- Height of measuring point above or below casing mark;
- Method of pumping;
- Static water level below measuring point;
- Distance from pumped well (N/A if pumped well);
- Discharge rate; and
- Time and date of commencement of test.

Water level measurements should follow the following schedule from commencement of pumping, for each discharge step interval:

- at 30 second intervals for the first 3 minutes;
- at 1 minute intervals from 3 minutes to 10 minutes;
- at 5 minute intervals from 10 minutes to 30 minutes;

An automated data logger may be used to record water levels during a test, and would start recording at least 2 seconds prior to commencement of pumping. If a data logger is used, manual water level measurements will be collected periodically to confirm that the data logger is operating correctly.

Immediately following completion of the step-drawdown tests, water level measurements will be made for the recovery period. Generally such tests take from 30 minutes to 1 hour, or until the water level has recovered to within 80 to 90% of the pre-pumping level.

Step-drawdown tests allow characterization of a well in terms of the "drawdown/discharge" relationship. The relationship between drawdown and discharge will be used to determine the optimum pumping rate for a long-term constant rate discharge test. Either the Eden-Hazel Method or the Hantush-Bierschenk Method (both discussed in Chapter 4 of the RCRA Facility Investigation Interim Report (November 1991)) will be used for the analysis of the step-drawdown test.

### Constant Rate Discharge Test

A constant rate discharge test will be performed on each of the two newly installed recovery wells upon completion of the step-drawdown test. The discharge rate to be used during the test will be determined from the analysis of the step-drawdown test.

During the test, drawdown with time will be measured in the pumping well and nearby monitoring wells and piezometers. At least one well, at a distance sufficiently far from the pumping well that pumping is not likely to influence water levels in the selected well(s), will be used to gather background water level data and will be monitored for a period of 48 hours preceding and following the test.

An automated data logger shall be used to record water levels in the wells selected to be monitored in conjunction with the test. Manual water level measurements will be taken periodically in these wells to confirm that the data logger is functioning properly. The following schedule should be followed upon commencement of pumping:

- at 30 second intervals for the first 3 minutes;
- at 1 minute intervals from 3 minutes to 10 minutes;
- at 5 minute intervals from 10 minutes to 90 minutes;
- at 10 minute intervals from 50 minutes to 100 minutes;
- at 20 minute intervals from 100 minutes to 180 minutes;
- at 30 minute intervals for the remainder of the test.

The duration of the test will be controlled by drawdown rates in the pumped well, water flows, and ability to store and/or dispose of discharged water.

Immediately following completion of the constant rate test, the pump will be shut down and water level measurements commenced for the recovery period. Recovery measurements will follow the same schedule as above. The recovery period will continue until the water level in the pumped well has recovered to within 80 to 90% of the pre-pumping level.

## Slug Test

New and existing monitoring wells and piezometers that are appropriate for slug tests (based on design and construction criteria) may be tested to estimate formation permeability in the immediate vicinity of each well. Slug tests involve submerging a slug cylinder in the water column of the well (falling head test). The change in water level versus time (the response) is recorded by an electronic pressure transducer and data processor. After the well has recovered, the slug is removed (rising head test) and the response is recorded.

In properly conducting the slug tests it is important to recognize whether or not the static water level is above or below the top of the well screen. Falling head tests run on wells having only partially saturated screens can produce misleading results through delayed drainage of water displaced into the gravel/sand pack during introduction of the slug. Consequently, rising head tests would be performed on all wells. Falling head tests would only be run on wells where the static water level immediately prior to the test is above the top of the screen, thereby eliminating the potential for generating misleading results. Procedures for slug testing are as follows:

### **i) PRELIMINARY PROCEDURES**

- a) Water level indicator probe, transducer, cable, and "slug" will be decontaminated before use as described in Section 6.8.
- b) Wells will be opened and water levels measured using the water level indicator. The water level indicator probe will be cleaned after use in each well.
- c) A "slug" will be selected, determined by the diameter of the well and a line attached to the "slug". This line will be marked at a distance from the bottom of the "slug" equal to the measured depth to water in the well, and at that distance plus the length of the "slug" (usually 4 feet).



The slug chosen will achieve a 2-4 foot vertical displacement of the static water level within the well.

## ii) FALLING HEAD TEST

- a) Establish and record the well and test slug characteristics (i.e., well depth, screen interval, slug diameter and length, etc.).
- b) Install the transducer in the well at a predetermined depth and connect it to the data logger. Input transducer and test specification, and prepare for the test start.
- c) Position the slug in the well, start the data logger (i.e., start the test) and then quickly submerge the slug. The data logger should start recording 1 or 2 seconds prior to dropping the slug. The data logger, or manual water level readings should follow the schedule below:
  - 30 second intervals for 5 minutes,
  - 1 minute intervals for 10 minutes,
  - 2 minute intervals for 20 minutes, and
  - 5 minute intervals for the remainder of the test.

The frequency of readings will depend upon the geologic material being tested. In materials likely to have high hydraulic conductivity values, more frequent readings will be required. In material with anticipated low values, fewer readings within a time period would be acceptable.

The duration of the test will be controlled by the nature of the materials being tested. Generally, the water level changes should be recorded until 80-90 percent of the excess head has dissipated. At this time the test can be terminated. During the test, the data being collected and stored by the data logger should be evaluated to see if the recorded data is reasonable. Manual

water level measurements should also be collected and compared to data logger values as a check to determine whether the equipment is operating properly.

**iii) RISING HEAD TEST**

- a) Establish and record the well and test slug characteristics (i.e., well depth, screen interval, slug diameter and length, etc.).
- b) Install the transducer in the well at a predetermined depth and connect it to the data logger. Input transducer and test specifications, and prepare for the test start.
- c) Position the slug in the well, start the data logger recording (i.e., start the test) and then quickly remove the slug. The data logger should start recording 1 or 2 seconds prior to removing the slug. The data logger, or manual water level readings should follow the schedule below:
  - 30 second intervals for 5 minutes,
  - 1 minute intervals for 10 minutes,
  - 2 minute intervals for 20 minutes,
  - 5 minute intervals for the remainder of the test.

The frequency of readings will depend upon the geologic material being tested. In materials likely to have high hydraulic conductivity values, more frequent readings will be required. In material with anticipated low values, fewer readings within a time period would be acceptable.

The duration of the test will be controlled by the nature of the materials being tested. Generally, the water level changes should be recorded until 80-90 percent recovery has been achieved. At this time the test can be terminated. During the test, the data being collected and stored by the data

logger should be evaluated to see if the recorded data is reasonable. Manual water level measurements should also be collected and compared to data logger values as a check to determine whether the equipment is operating properly.

The In-Situ SE 1000B (Hermit data logger) will be used to automatically record slug test data in the field. Field data will be downloaded at WCC's office into a computer for subsequent analysis. All slug test data will be analyzed using the method of Bouwer and Rice (1976) for unconfined aquifers. The Bouwer and Rice method will be applied using ISOAQX software developed by Hydralogic Inc. (1987). ISOAQX is an interactive model for aquifer analysis that uses published, well recognized analytical solutions to establish aquifer hydraulic parameters.

Decontamination of the aquifer testing equipment following slug tests will be in accordance with the procedures described in Section 6.8.

**6.2.7.2 In-Situ Ground Water Sampling Procedures.** In-situ ground water samples will be collected with a Hydropunch™. In-situ ground water samples are collected by driving or pushing the Hydropunch™ to the desired sampling depth. The following procedures will be used during this investigation:

- The boring is augered to a point just above the desired sample depth.
- The Hydropunch™ is driven or pushed past the bottom of the borehole (3 to 5 feet) to the final sample depth.
- The drive casing is then pulled back, permitting ground water to enter the Hydropunch.™
- When an adequate volume of water has filled the Hydropunch™, a small stainless steel bailer with a Teflon check valve assembly will be used to collect the ground water.

- The Hydropunch™ is decontaminated before collecting the next sample.
- Test borings not intended for monitoring well installation will be backfilled with a cement/bentonite grout.

The location for the samples will be determined from the results of the soil gas survey. The samples will be analyzed for Appendix IX volatile organic compounds.

**6.2.7.3 Well and Piezometer Development Procedures.** Wells will be developed to improve the hydraulic communication between the formation and monitoring wells and to help assure that representative ground water samples will be collected. During the drilling process, the side of the borehole may become smeared, which substantially retards the movement of water into the well. In addition, soil may enter the filter pack or temporarily clog the well screen slots during installation of the well materials.

Well development is the process of flushing the interface between the aquifer and the well. In addition, the filter pack and screen slots are cleaned, allowing ground water to flow into the monitoring well with a minimum of retardation. Development is required to (1) restore the natural permeability of the formation adjacent to the borehole, (2) remove clay, silt, and other fines from the filter pack and well screen so that subsequent water samples will not contain excessive suspended matter; and (3) remove remnant drilling fluids and contaminants potentially introduced during drilling activities.

The development process is best accomplished by causing the natural formation water inside the well screen to be moved vigorously in and out through the screen in order to agitate the clay and silt. This causes clay and silt particles to be moved into the well where they can be removed or lodged into the sand pack and/or formation. Formation water will be used for surging the well. The progress of well development will be monitored with a turbidity meter and/or a temperature and conductivity meter. Measurements will be recorded every five minutes. Development will be discontinued when four consecutive readings are the same or when a maximum of one hour of development occurs. If during development the well goes dry, alternate pumping and recovery will be used up to one hour.

Equipment used for well development will be cleaned before each use to prevent possible cross-contamination of the wells. Decontamination procedures are detailed in Section 6.8.

Development of each well will be accomplished by pumping or bailing. These methods will serve to remove silt-laden water. A bailer which is heavy enough to sink rapidly through the water can be raised and lowered through the water column to produce an agitating action that is similar to that caused by a surge block. The bailer has the added capability of removing turbid water and fines each time it is brought to the surface.

A submersible pump can be used effectively where recharge is rapid. Surging can be accomplished by switching the power source on and off while pumping, causing ground water to move in and out through the screen, achieving the desired cleaning action. The size of the pump used is contingent upon the well design and associated recharge rate.

The Hydrolift® pump may also be used for development. This is a reciprocating pump which recovers groundwater through a tube and foot valve assembly, utilizing the inertial lift principle. This method is especially effective for pumping water heavily laden with sediment.

The well development procedure selected for use by the inspector(s) will be based on conditions encountered during well installation and the conditions associated with existing monitoring wells. Development water will be handled as described in Section 6.8.

**6.2.7.4 Ground Water Sampling Procedures.** Initial ground water samples will be collected two weeks or more after the wells have been developed. A summary of ground water sampling locations and associated analyses to be performed is provided in Table 15-2 of the Phase II Proposal (November 1991). All of the newly installed and existing monitoring wells will be sampled during Rounds 1 and 2 of Phase II. A submersible or Hydrolift® pump will be used to purge each well prior to sampling. A minimum of three well volumes will be purged by continuous pumping. During pumping the intake will be raised above the dynamic (pumping) water level twice (while the pump is running) to

ensure complete evacuation. If the well yield is low, then the well may be pumped dry once. Wells that are pumped dry will be allowed to recharge. The amount of water purged from each well will be recorded in the field notebook by the sampler(s) on site. Water generated during purging will be handled as described in Section 6.8. Static water levels will be measured prior to purging each well as described in Section 6.2.8.

Wells will not be sampled until they are 80 percent recovered or recovered above the screened interval. Regardless of percent recovery, all wells will be sampled within 2 hours of purging. A laboratory cleaned, dedicated stainless steel bailer with a teflon check valve assembly will be used to collect the ground water samples. The suspension line attached to each bailer will consist of a teflon cord. When lifted from the well the bailer and cord will be held in the air and will not be allowed to touch the ground or any other potentially contaminated surface. All members of the sampling team handling bailers and suspension cords or filling sample containers will wear surgical gloves during sampling activities. Gloves will be changed between each well sampling.

The method of sampling will be to lower the bailer smoothly into the well to a point approximately opposite the middle of the well screen. At this point, the bailer will be gently worked up and down to ensure that water from that depth will enter the bailer. Substantial agitation of the water column will be avoided, as this could result in volatilization of volatile organic compounds. The number of bailerfuls used to fill the sample bottles will be minimized.

Sample containers will be filled in the following order:

1. field sample for pH, temperature, dissolved oxygen, and specific conductance;
2. volatile organic vials;
3. semi-volatile sample containers;
4. other organic parameter containers;

5. inorganic sample containers; and
6. field sample for pH, temperature, dissolved oxygen, and specific conductance.

Ground water samples collected for inorganic analyses will be analyzed for both dissolved and total metals. During sample collection, ground water samples for inorganics will be split into two portions. One portion will be field filtered using a pump (hand operated or electric), new 0.45 micron filters (glass or membrane) and dedicated disposable filter bottles, and collected into dedicated laboratory cleaned sample containers. After filtration, samples will be preserved with nitric acid to a pH of less than 2, and analyzed for dissolved metals. The remaining unfiltered portion will be preserved with nitric acid and analyzed for total metals.

**6.2.7.5 Immiscible Layer Sampling Procedures.** If immiscible layers are detected in monitoring wells they will be sampled separately. Immiscible phases will be sampled prior to well purging. If a floating immiscible layer is encountered and it is at least 2 feet thick, a bottom valve bailer will be used to collect a sample. The bailer will be lowered slowly into the immiscible phase to a depth less than the depth of the immiscible/water interface depth. If the floating immiscible layer is less than 2 feet thick, it will be sampled using a peristaltic pump equipped with teflon tubing. This pump is considered a viable option because static water levels are expected to be within 25 feet of ground surface.

If dense immiscibles (sinters) are encountered, they will be sampled using a double check valve teflon bailer. The sample will be collected by slowly lowering the bailer to the bottom of the well. The bailer will be removed from the well slowly to avoid intermixing. The sample will be transferred to sample containers through the bottom check valve to ensure that only the dense phase is collected.

Extracted ground water will be temporarily stored on site. Subsequent handling will be based on analytical results of ground water samples. If analytical results of ground water samples indicate that the water may need to be disposed of as hazardous waste, composite samples will be analyzed for TCLP.

## 6.2.8 Water Level Measuring Procedures

Ground water levels will be measured in all piezometers and monitoring wells within 24 hours prior to each ground water sampling event and monthly during Phase II. Static water levels will be measured with reference to a surveyed point (temporary bench mark) on the riser pipe. An incised arrow on the inside of the casing will be used to mark the surveyed reference point on the riser rim. The reference point will be established by a licensed surveyor to the nearest 0.01 foot and will be referenced to an established National Geodetic Vertical Datum.

Water levels will be measured using an electronic water indicator equipped with a tape marked at 0.05 foot intervals and a stainless steel probe. Measurements will be taken to the nearest 0.01 foot. The water level meter will be decontaminated between each well/piezometer measurement. The decontamination procedure will consist of the following:

- wash with an Alconox/potable water solution;
- rinse with distilled water;

In addition, automated water level recorders may be used at selected wells on site. Aquistar® single-channel data loggers measure the height of water column overlying connected transducers and can be programmed to log at any selected time interval. The optimum logging interval for this application is every thirty minutes. This interval ensures that exceedences of either the memory storage or battery life do not occur.

Manual water level measurements will be collected monthly to confirm that the data logger is operating correctly.

Water level data from these recorders provides information on daily water level fluctuations and the dynamics of the groundwater system. In addition, the hydrographs from the recorders are used to estimate the specific yield and recharge to the aquifer.



Maintenance procedures for the water level recorders are described in Table 13-1.

**6.2.8.1 Detection of Immiscible Layers.** The procedures described in Section 4.2.2 in the RCRA Ground Water Monitoring Technical Enforcement Guidance Document (TEGD) will be followed to detect the presence of immiscible layers in monitoring wells. Immiscible contaminants are those relatively insoluble organic liquids which either float and spread across the potentiometric surface or migrate vertically through the aquifer to the underlying confining bed. This procedure will be used during the first round of water level measurements to check for immiscible layers. If none are detected, standard water level measuring techniques will be used as described in Section 6.2.8 during following rounds of water level monitoring.

The following procedures will be implemented to detect the presence of immiscible layers:

- the locking and protective caps will be removed;
- the well headspace will be analyzed using an Hnu or OVA; and
- an MMC Tri-mode interface probe will be lowered into the well to determine the presence of any immiscible layers.

As the interface probe is lowered into the well, the probe will register when it is exposed to an organic liquid. After passing through the light phase immiscible layer, the probe will indicate the depth to the water table. Therefore, an accurate determination of the thickness of the light phase immiscible layer can be made. Dense phase immiscible layers (DNAPL's) will be detected by lowering the probe to the bottom of the well. The interface probe will again register when exposed to the dense phase immiscible layer.

The interface probe will be decontaminated between each well/piezometer measurement as described in Section 6.8.

### **6.2.9 Surface Water Sampling Procedures**

Samples will be collected by manually submerging laboratory cleaned sample containers into the water. Prepreserved sample containers will be filled by transferring water collected into a non-preserved container. Surgical gloves will be worn to collect samples and will be discarded between sampling locations.

After collection, samples will be packed in an ice-filled cooler and handled in accordance with procedures described in Section 6.3.

### **6.2.10 Bed Sediment Sampling Procedures**

Bed sediment samples will be collected for chemical analysis at twenty-seven locations along the facility reach. In addition, two surficial bed sediment samples will be collected from the pond located in the Waste Water Treatment Area for laboratory chemical analysis. Sediment samples will be collected with one of three sediment sampling techniques (vibracore, push core or grab sampler). A core or grab sample will be retrieved at each sampling location and submitted for chemical analysis and Fingerprint Compounds. The proposed bed sediment sampling locations are depicted on Figure 15-8 of the Phase II Proposal (November 1991). Actual locations will be determined based on the river reconnaissance conducted during the bathymetric survey and other work conducted during the hydrologic study.

Sample descriptions will follow the procedures outlined in Section 6.2.1.2. Sampling equipment will be decontaminated as described in Section 6.8. Sample handling and custody procedures will be as described in Sections 6.3 and 7, respectively.

#### Vibracore

The vibracore will be used wherever possible because it is capable of collecting a continuous sample up to five feet in length. The corer consists of three inch diameter tubing that is driven into the sediment with a vibratory head bolted to the top of the tubing.

The air driven vibratory corer is mounted on a 15-foot spud barge. Either anchors or spuds, depending on water depth and wind conditions, will be used to maintain a stationary position during coring. Upon recovery of a sediment sample, the sample will be described using the soil classification procedures described in Section 6.2. Sampling equipment will be decontaminated as described in Section 6.8.

#### Sediment Push Cores

In shallow water, if the vibracore cannot be used because of the presence of rocks or limited sediment depth, a hand-pushed corer will be used. The hand pushed corer is roughly three feet long and has a metal barrel with a plastic liner. A "T" handle is mounted on top and a core catcher and cutting shoe are attached to the bottom. Upon recovery of a sediment sample, the sample will be described using the soil classification procedures described in Section 6.2. Sampling equipment will be decontaminated as described in Section 6.8.

#### Grab Sampler

A grab sampler (Ponar sampler or Eckman dredge) may be used in those areas where the vibracore cannot penetrate and the water is too deep for a hand-pushed corer. Ponar grab samplers cover an area of 81 square inches and penetrate up to 4-inches of surface sediments. Upon recovery of a sediment sample, the sample will be described using the soil classification procedures described in Section 6.2. Sampling equipment will be decontaminated as described in Section 6.8.

### **6.2.11 Soil Gas Survey Procedures**

Soil gas sampling for selected volatile organic compounds will be performed as a field screening procedure in Phase II. Sampling locations and analyses to be performed are summarized in the Phase II Proposal, (November 1991). Soil gas probes will consist of 3/4-inch diameter hollow steel pipes with detachable drive tips.

Soil gas probes will be advanced by a specialized hydraulic mechanism or a hydraulic hammer to assist in driving probes past cobbles and building debris, if encountered. Once the probe is advanced to the proposed sampling depth, the above-ground end of the probe will be connected to a vacuum pump and a seal will be created at the ground surface to ensure a good vacuum. The vacuum pump will purge 5 volumes of air from the probe. Soil gas flow will be monitored by a vacuum gauge on the sampling stream line and a pressure rotometer in line on the exhaust of the vacuum pump to ensure adequate flow. Monitoring of the vacuum gauge will be performed to ensure that a good vacuum seal is made. Soil gas samples will be collected using a Popper and Sons all glass syringe and stainless steel needle. By drawing approximately ten milliliters of gas into a glass syringe, the sample does not come in contact with any sorbing materials. After collection, the soil gas sample will be analyzed in the field with a gas chromatograph. Although stability tests conducted on the analytes of interest indicate that samples can be held for up to 4-5 hours if kept cool and out of direct sunlight, all soil gas samples will be analyzed within 20 minutes of sample collection. Soil gas probes will be decontaminated before collecting each sample for analysis as described in Section 6.8. If rain occurs during sampling, selected locations will be resampled at a later date (and under drier conditions) to correlate the data collected from both sampling events.

#### 6.2.12 Soil Gas Analytical Procedures

A laboratory grade gas chromatograph will be used for soil gas analyses. It will be equipped with an Electron Capture Detector (ECD), and a Flame Ionization Detector (FID). Quantification of compounds will be achieved by comparison of the detector response of the sample with the response measured for calibration standards. Laboratory grade nitrogen gas will be used as a carrier gas.

Soil vapor detection limits for the compounds of interest are:

- |   |         |   |              |
|---|---------|---|--------------|
| • | TCA     | - | 0.0001 ug/L; |
| • | TCE     | - | 0.0001 ug/L; |
| • | 1,2-DCA | - | 0.01 ug/L;   |

- |   |                    |   |            |
|---|--------------------|---|------------|
| • | chlorobenzene      | - | 0.1 ug/L;  |
| • | meta & para-xylene | - | 0.02 ug/L; |
| • | ortho-xylene       | - | 0.02 ug/L; |
| • | toluene            | - | 0.02 ug/L; |
| • | ethyl-benzene      | - | 0.02 ug/L. |

Soil vapor detection limits are low enough to locate the potential source areas and are consistent with the field screening objectives.

Prior to sampling each day, system blanks are run to check the sampling apparatus (probe, adaptor, 10 cc syringe) for contamination by drawing above-ground ambient air through the system and concurrently comparing the analysis to sampled ambient air. Subsampling of syringes are checked for contamination prior to sampling each day by injecting nitrogen carrier gas into the gas chromatograph. Duplicate subsample analyses are to be performed on each soil gas sample drawn from each sample probe. All sampling syringes (including 2 cc subsampling syringes) are decontaminated each day before being used. Glass syringes are used for only one sample per day before being decontaminated. A sufficient number of syringes (of each type) will be available to complete a day of sampling without interruption for decontamination.

## Calibration Procedures

### Gas Chromatograph

An initial 3 point calibration will be performed on the gas chromatograph (GC) for the analytes of interest. The chemical standards used for calibration will be traceable to Chem Service, Incorporated. A standards preparation log will be maintained which will include records of chemical names, lot numbers, purity, weights or volumes diluted, initial and final concentrations and date of standards preparation. Once instrument linearity has been determined, one or more daily calibration check standards will be analyzed to ensure that the analytical measuring system is in control. The criteria for a successful daily calibration check is that the responses for the compounds of interest are within 25% of the mid-level standard from the last 3 point calibration. If this level

of performance cannot be attained for the check standard, then another initial calibration will be performed. The analyst will also run additional check standards as required based on his professional judgment.

System blanks will be run daily to check for interfering background signals caused by contamination. If blank contamination is encountered, corrective measures will be carried out to eliminate interferences. The analyst will run additional blanks as required based on his professional judgment.

Blank contamination is defined as chromatographic peaks which are not already present in the ambient air system blank and occur within the chromatographic region of interest. The corrective action is to sample ambient air through sections of the sampling train from the injection port back toward the sampling probe until the source of contamination is isolated. The isolated source of contamination will then be documented. For example; if a sampling probe or syringe were found to be contaminated, then all syringes and probes would be decontaminated.

The instrument parameters are as follows:

<u>Instrument:</u>	Varian 3300 Gas Chromatograph
<u>Detectors:</u>	Varian ECD Varian FID
<u>Injector Temperatures:</u>	150°C
<u>Detector Temperatures:</u>	300°C
<u>Analytical Columns:</u>	6' OV 101 on Chromosorb 6' SP 1000 on Carbopak
<u>Temperature Program:</u>	70°C 5 minute initial temperature, 15°C/minute temperature ramp, 170°C final temperature
<u>Injection Volume:</u>	1 ul to 1 ml

The analyst may change GC conditions based on his analytical judgment. A GC log will be maintained which will include detailed descriptions of analytical procedures, instrument parameters, sample analysis (times, dates and volumes) and the analysts's signature.

### 6.2.13 Headspace Analysis

For each soil or sediment sample collected, a subsample will be reserved for headspace analysis for organic vapors in the field. Results of these analyses will be used to refine plans for additional sampling and estimate the extent of volatile contamination at the site where laboratory data are not available.

Field headspace analysis will be conducted using the following procedures:

- depending on sample volume collected approximately three ounces of sample will be transferred to a four ounce sample jar and sealed with a laboratory sealing film (Parafilm). If sample volume collected is minimal, then that amount of sample will be transferred;
- sealed samples will be placed in an ice filled cooler or refrigerator to be held for analysis at the end of one day of sampling;
- before analysis, samples will be warmed in a 100°F water bath for 15 minutes;
- after warming, an incision will be made in the Parafilm on the sample jar and the probe of a Foxboro Organic Vapor Analyzer 128 (OVA) will be inserted together with an HNu PID Analyzer; and
- a total organic vapor measurement will be recorded.

The OVA and HNu will be calibrated daily, or more frequently if anomalous results are noted. Calibration procedures for the OVA and HNu are detailed in Section 8.6.

#### 6.2.14 Hydrographic (Bathymetric) Survey Procedures

Hydrographic data will be collected with an International Measurement Control (IMC) Hydro I surveying system linked with a SIMRAD precision depth sounder. The Hydro I is a fully-automated range azimuth surveying system which uses laser technology with conventional surveying techniques to provide complete hydrographic surveying capabilities. The shore unit of the Hydro I consists of 1) a Lietz 20" directional theodolite, 2) an electronic distance measuring instrument (EDMI), 3) a microcomputer, and 4) a two-way radio. The ship unit of the Hydro I includes 1) glass prisms to which distances are measured, 2) a microcomputer with navigational software, and 3) a two-way radio. The SIMRAD echosounder mounted on the boat contains 1) a transducer, 2) a processing unit with a Canon color recorder, and 3) a digitizer.

The shore unit is set up directly over a position for which x and y coordinates have previously been determined. These control points can be coordinates of an independent system or they can be tied to state plane or Universal Transverse Mercator (UTM) coordinates. The theodolite is mounted on a tripod and the EDM I fastened to the theodolite. The instruments are wired directly to the shore computer.

The ship unit is arranged so that the transducer is mounted directly below the prisms, thus, x and y data (horizontal position) will correspond with z data (depth). During the surveys, the person at the shore unit will track the prisms with the theodolite. Azimuth and distance data logged onto the shore computer are used to calculate the x and y coordinates of the boat. The x, y, and z coordinates are transmitted by radio to the shipboard computer where all of the data are stored. The system cycle speed is every 0.7 seconds, and x, y, and z coordinates will be logged into the computer at preset distance intervals. The data will be processed with software provided by IMC and imported into LOTUS 1-2-3™ and graphically contoured by SURFER™ or LICONTOUR™ to produce contours of the river bottom.



#### **6.2.15 Stage Height and Datalogger Measurement Procedures**

The datalogger (e.g., Instrumentation Northwest Inc. (INW) Aquistar®) combined with a pressure transducer (e.g., INW PS9000) is capable of providing a reliable, continuous stage elevation measuring system. Because the datalogger requires protection from environmental variables such as temperature and moisture, it will be placed inside an enclosure for protection from weather and vandalism. This housing should have openings with gaskets for wires and be capable of storing the datalogger, storage module and batteries. It will be located so that it is easily accessible for downloading stage data, programming and calibration, changing desiccant packs, and changing batteries for charging. After the datalogger is securely mounted, the pressure transducer is connected. All wiring, power connections, data collection, calibration and programming will be performed in accordance with the manufacturer's instructions.

The transducer and cable will be securely anchored and thus protected from high velocities and floating debris in the water. The cable will be placed in buried PVC pipe (larger than the diameter of cable and transducer) from the edge of the water to the datalogger to provide protection from animals and vandalism, and allow easy replacement if necessary. The transducer then will be connected to the datalogger according to the manufacturer's operation manual.

Stage data will be downloaded from the datalogger on a monthly basis. Downloading is accomplished by using a portable microcomputer equipped with an Aquistar Interface cable. Data is downloaded in ASCII format for ready import into modeling software. A staff gage will be installed adjacent to the site for field verification of pressure transducer/datalogger results. The system will be inspected monthly to ensure that it is operating properly.

#### **6.2.16 Sequential Water Sampling Procedures**

A continuous sequential water sampler will be used at three stations to collect daily sequentially composited water samples. Each station will consist of a small building (concrete block or metal construction) which will house the sampling equipment (e.g.,

water sampler, datalogger). Before any installation begins, it is necessary to determine if an additional pump source is required by measuring the distance between the water and water sampler. Water will be pumped from the river to the building and back to the river on a continuous basis inside buried PVC pipe to protect from freezing and vandalism. An external power source will be required to operate the sampler and an additional pump if necessary. The water sampler will be programmed according to the manufacturer's operation manual to obtain the required sample. Filters will be placed on the suction line to prevent floating debris from being drawn into the line. Filters will be cleaned and/or repaired on a regular basis. Sample containers within the water sampler will be removed and replaced with empty containers when sampling capacity is reached. The samples will be refrigerated in the sampler to maintain samples below ambient temperature for analytical purposes. Samples will be collected on a weekly basis and the system will be inspected during the weekly sampling.

#### **6.2.17 River Water Sampling Procedures**

The following steps will be followed during collection of river water samples from mid-depth:

- A boat, equipped with discrete water samplers (e.g., Kemmerer samplers, Alpha bottles) and a pump with components that will not cause interference in the analyses to be performed on the sample, is positioned over the sampling location by measuring distance from the bank or using electronic distance measuring devices.
- A minimum field crew of two people, familiar with boating safety and equipped with personal floatation devices and other necessary personal protective equipment as specified in the site Health and Safety Plan, will attend the boat at all times.
- The total depth of the water column at the sampling location is measured by dropping a weighted, metered line to the bottom of the river. Total water depth is recorded in the field log, along with the date, operators, sampling

location, weather conditions, and any other information required so that an independent party could duplicate the sampling effort from the field log.

- If discrete samples are collected, the sampler is lowered to one-half the total depth of the river at the sampling location, allowed to equilibrate with the surrounding water, stoppered and returned to the surface. The sampler construction materials must be consistent with the type of analyses being performed on the sample (i.e., glass containers for organics, plastic for metals, etc.) as specified in the site field sampling plan. The sample is poured into the sampling containers, filling the volatile organic sample container first to minimize loss of volatile compounds from the sample. Samples are labelled, preserved as required for the analytical protocols to be performed and shipped overnight or delivered to the analytical laboratory under documented custody procedures. Sample numbers should be consistent with the field sampling plan.
- If large volumes of sample are collected using the pump, the intake line is weighted to descent to one-half the total depth of the water column. The pump is turned on and purged for one minute prior to sample collection. An equipment blank is collected first to quantify any residual contamination existing in the pump or lines. The equipment blank is handled in the exact manner as all other samples (collected in sampling containers, as the other river water samples, and preserved and shipped with the remaining samples to the laboratory for analysis). The remaining sample volume will be collected in intermediate containers, consistent with the analyses to be performed on the samples (i.e., plastic for metals glass for organics, etc.).
- If samples require filtering, this procedure can be performed either on the boat using a portable generator and filtration device, or at the site, at the discretion of the field sampling coordinator. For the water samples to be collected as part of the Phase II Water Quality Monitoring Program, 100 liters of sample will be filtered through a .45  $\mu\text{m}$  filter to collect one liter of sample

for analysis. Samples will be preserved, labelled, sealed and delivered to the laboratory as specified in the field sampling plans.

- Equipment decontamination will be consistent with the types of contaminants expected to be present in the samples. The pump, remote sampler and intermediate containers will be decontaminated after each sample and the decon fluids will be retained for proper disposal.

### 6.3 SAMPLE HANDLING

Samples collected in the field for laboratory analysis will be placed directly into sample containers specifically prepared for that analysis or compatible parameters provided by the laboratory performing the analyses. The laboratory will ship sample containers and reagent preservatives to CIBA-GEIGY's consultant not more than five days before the beginning of the sampling event. Completeness and integrity of container sets will be verified upon receipt by the Sample Coordinator so that deficiencies can be remedied in advance of the sampling event.

Individual sample containers will be sealed by hand tightening container lids. Water sample vials for volatile organic analysis will be filled leaving no headspace. This will reduce the chance for escape of volatiles from the sample. Headspace will be checked by inverting the vials and tapping to induce any bubbles present to rise. If bubbles are present, the sample in the vial will be discarded and a new sample will be collected. Soil samples will be loosely placed in vials with minimal headspace for volatile analysis. All other sample containers will be filled to their necks. Reagent preservatives will be added in the field immediately after sample collection.

The Sample Coordinator will be responsible for sample handling from the sampling team to shipping to the laboratory. Once sealed, the samples will be placed in ice-filled coolers or a refrigerator for storage till shipping. The "ice" used to fill coolers for sample shipment will be blue ice packs which have been frozen for at least 8 hours before being placed in sample coolers.

Samples for chemical analyses and associated QA samples (see Section 11) will be shipped to the laboratory within 24 hours of sample collection. The laboratory will be notified to be prepared to receive a shipment of samples. This, too, will reduce the possibility of holding time exceedence. Samples will be packed in styrofoam or bubble wrap to minimize breakage. Samples will be shipped in accordance with local, state, and federal government regulations.

Coolers will be sealed with tape and secured with a signed custody seal. The custody seal will provide an indication of whether the cooler was opened by unauthorized personnel. During sampling events, partially filled and unfilled coolers will be kept within sight of the sample custodian or locked in a vehicle or job trailer. The sample custodian will be a designated member of the sampling team.

Sample custody documentation is described in Section 7.

## **6.4 GROUND PENETRATING RADAR SURVEY PROCEDURES**

### **6.4.1 Introduction**

Ground penetrating radar (GPR), also known as impulse radar or monopulse radar, provides a rapid, high-resolution means of generating continuous graphic records of subsurface conditions. GPR is usually used as a surface-based reflection profiling technique, similar to seismic reflection. Depending on the electrical and geologic properties of the media being scanned, it is possible to locate buried tanks, drums and utilities, measure depth to bedrock, delineate the boundaries of a landfill, locate subsurface cavities and map steel reinforcing in concrete. Other uses of GPR include ice thickness mapping, fracture detection, buried foundation mapping, lake and river profiling, and pipeline mapping and leak detection.

The method involves irradiating the near subsurface with wide band, short duration electromagnetic energy from a transmitting antenna. The energy reflected from subsurface features is intercepted with a receiving antenna and the return signal is amplified and processed to convert it to a graphic record for interpretation.

Because electromagnetic energy attenuates rapidly in conducting materials, ground penetrating radar is a shallow-penetration technique. Penetration depths are rarely more than a few tens of meters, and the vast majority of surveys provide useful information only from the top 3 or 4 meters. GPR works well in resistive materials such as dry rocks or fresh water-saturated clean sand, and does not work in conductive materials such as clay or rocks with conductive pore fluid.

#### **6.4.2 Survey Design**

Ground penetrating radar will be used in a survey in the Production Area. Data will be collected at 10 foot intervals in a grid pattern to maximize the amount of information produced in that area. In the Waste Water Treatment Area and Warwick areas a 20-foot grid will be used.

##### **6.4.2.1 Necessary Equipment**

- Geophysical survey Systems SIR System 8 or equivalent
- High-speed graphic line scan recorder
- Magnetic tape recorder (optional)
- Wood stakes or pin flags
- Marking paint
- Measuring tape or wheel
- Flagging
- Notebook, pens, etc.
- Compass

**6.4.2.2 Field Procedures.** A standard field procedure for collecting GPR data is described below. Preliminary considerations have to be made prior to initiation of any data collection. These preliminary considerations include at a minimum:

- Review existing and appropriate site, area, and regional subsurface geologic and hydrogeologic information including soil characteristics, especially conductivity.

- Define any known hazards that pose a threat to the safety of field personnel.
- Define the purpose and expectations of the subsurface investigation.
- Determine appropriate field parameters, given the purpose of the survey (transect spacing, length, choice of antenna, depth of penetration, etc.).
- Survey the locations of line endpoints along each transect and denote these endpoints in the field with wood stakes or pin flags, labeled with an alphanumeric code identifying them within the survey grid.

Design of appropriate field parameters must consider the following:

- Spacing between transects must be appropriate for the size of the objects or features the survey is designed to detect. Actual line spacing chosen must consider resolution desired and maximum depth required.
- Transects to be surveyed must be clear of vegetation and other obstacles such as parked cars, machinery, lumber, scrap, litter, etc. To produce a good quality GPR record it is necessary to generate a continuous scan by moving the antenna over (and in contact with) the ground surface in a smooth, uninterrupted motion. Sometimes this is done by hand, and sometimes the antenna is towed by a vehicle, depending on the nature of the survey and the terrain.
- Background soil conductivity must be evaluated and/or determined to assess the potential success of a GPR survey. High soil conductivity or the existence of interbedded conductive layers (such as clay) can make interpretation difficult if not impossible, and can cause significant anomalies to be obscured and overlooked.

A standard field procedure for conducting a GPR survey is described below.

1. Perform a visual survey along the proposed lines. The visual survey will include a review of site utility plans; check for overhead wires, manhole covers, etc.
2. Note excessive amounts or large pieces of metal or water on the ground surface.
3. Note large nearby variations in topography.
4. Check system for adequate power supply and proper operation, and that range and gain controls are adjusted appropriately for the survey objectives and for maximum record clarity.
5. Initiate site survey traverse by towing the GPR antenna, with the system recorder running, beginning at the line endpoint and continuing along the transect to the opposite endpoint. Repeat for each transect.
6. Obtain the hard copy of each line of GPR data from the graphic recorder and label with appropriate identification and notations made on the record to correspond to notes made in the field notebook.

#### **6.4.3 Data Reduction and Interpretation**

A standard procedure for reducing and interpreting GPR data is described below.

1. Plot GPR reflection anomalies over a graphical representation of the surveyed site for each transect.
2. Comparing the results of all plots, look for reflection patterns consistent with pipes, tanks, etc., and other features pertinent to the survey.



3. Using available borehole information and any other existing geophysical or engineering data as a reference, develop a subsurface model that is consistent with all available information.

## **6.5 SEISMIC REFRACTION SURVEY PROCEDURES**

### **6.5.1 Introduction**

Seismic refraction techniques have been useful for assessing hydrogeologic conditions such as depth to bedrock; depth, thickness, dip, and density of lithologic units; horizontal and vertical extent of anomalous geologic features, the approximate depth to the water table, and delineation of paleochannels.

The method consists of measuring the travel times of compressional waves generated by a surface source that are critically refracted from subsurface interfaces and received by surface receivers or geophones. First-arrival travel times of seismic energy plotted against source-to-receiver distance on a time-distance curve are characteristic of the material through which they travel. The number of line segments indicates the velocities of the layers. Based on the velocity information and appropriate time-intercepts, depth sections can then be calculated for each seismic spread.

### **6.5.2 Survey Design**

Three seismic refraction survey lines will be run to provide continuous profiles of the underlying rock and other refracting units and ground water within the overburden. One survey line will be run in the Production Area parallel and close to the river. One survey line will be run near the center of the Waste Water Treatment Area perpendicular to the river. In the Warwick Area one survey line will be run parallel and close to the river in the area opposite the Waste Water Treatment Area.

**6.5.2.1 Necessary Equipment.** The following is a list of the minimum equipment necessary to collect data for the seismic refraction survey:

- 24-channel, signal-enhancing seismograph with power supply and power cables (12-channel unit can be used for small projects);
- printer for seismograph and extra printer paper;
- recording media (cassette or discs depending on seismograph);
- two 12-channel seismic refraction cables;
- twenty-six seismic refraction geophones (low frequency);
- trigger wire (350 feet minimum);
- 16-pound sledge hammer and seismic source plate and/or seismic explosives and blasting system (approximately 1 pound dynamite per shotpoint or equivalent);
- field notebook;
- pens with non-water soluble ink;
- hand level;
- survey rod; and
- cloth tape (200 feet minimum).
- compass.

**6.5.2.2 Field Procedures.** A standard field procedure for collecting seismic refraction data is described below. For the purposes of this procedure, however, it is assumed that preliminary considerations have been made prior to initiation of any data collection. These preliminary considerations include as a minimum:

- Review existing and appropriate site, area, and regional subsurface geologic and hydrogeologic information including soil characteristics.
- Define any known hazards that pose a threat to the safety of field personnel.
- Define the purpose and expectations of the subsurface investigation.
- Determine appropriate field parameters, given the purpose of the survey (geophone spacing, shot layout, and line locations).
- Survey the locations of spread endpoints along each line and denote those locations in the field with lath or other wood stakes.

Determination of appropriate field parameters must consider the following:

- The length of a seismic refraction line must be a minimum of three times, and optimally, four times the maximum penetration depth required. This length will ensure that seismic energy will be received from refractors down to the required penetration depth.
- Spacing between individual geophones controls the degree of resolution available; a spacing of 10 to 50 feet is commonly used. Actual geophone spacing chosen must weigh resolution desired and maximum depth required.
- Long seismic lines (more than one spread) are shot using the method of continuous inline reversed refraction profiling, whereby the entire seismic line is shot in segments.
- Shot points are located at each seismic spread end, at one or more intermediate points along each spread, and beyond the end of the spread, depending on the required resolution. The end shot point of each spread segment coincides with an end or intermediate position shot point of the succeeding spread.

- Contained explosive sources are used for spread end shot points. Mechanical sources (sledge hammers, etc.) can sometimes be used for intermediate shot points, and can be used for spread end shot points if desired depth penetration is less than 40 feet.

A standard field procedure for collecting refraction data is described below:

1. Perform visual survey along the proposed seismic spread. The visual survey will include a review of site utility plans; check for overhead wires; check for manhole covers, buried cables, or buried gas line indications; and have telephone and utility site locators clear any potential shot point locations.
2. Beginning at spread end, and using cloth measuring tape, lay out geophone cables and geophones at determined geophone spacing along the spread.
3. Scrape off the upper few inches of surface soil for emplacement of geophones to increase coupling.
4. Connect geophones to appropriate takeouts on geophone cables and connect geophone cables to seismograph at a convenient location for optimal ease of instrument operation.
5. Set instrument gains for each channel appropriately for each individual shot point and test each channel for continuity and noise levels. Adjust gains accordingly.
6. Place seismic source at required source location and connect seismic trigger circuit to seismograph.
7. Initiate seismic source and record on seismograph. Observe trace data on seismograph and confirm good quality first-arrival information for each channel. If good quality first arrivals are not obtained using a hammer source, stack the data with additional hammer blows.

8. After satisfactory trace data are obtained, save the data with the appropriate seismograph recording media, and obtain hard copy of trace data on printer.
9. Ensure that all appropriate spread and shot location parameters are denoted on hard copy.
10. Repeat above procedures for each shot point and each subsequent seismic spread.
11. Following completion of data collection for each spread, and prior to moving to next spread, hand-level survey each geophone location. Use the spread end as a reference point for the elevation data. Recording of elevation data to the nearest one-tenth of a foot is sufficient.

### **6.5.3 Data Reduction and Interpretation**

A standard procedure for reducing and interpreting the refraction data is described below:

1. Determine relative elevations of each geophone location. If available, tie relative elevations to absolute elevation control for spread endpoints.
2. Analyze trace data for each shot point and determine first-break arrival time to nearest millisecond.
3. Record elevation results, first-arrival times, geophone and shot point locations in table form.
4. Input information from table for each spread to interactive processing package for further processing. (Note: Operator of seismic refraction processing routine will be trained personnel thoroughly familiar with the particular processing scheme being used.)

5. Prepare time versus distance plots for each spread manually or with the processing package and determine number of subsurface layers and associated velocities for each plot.
6. Prepare depth sections for each seismic spread based on results obtained from the time-distance plots using the processing package or method.
7. Compare, correlate, and interpret depth sections with available borehole information and results of previous and subsequent spreads to develop a consistent subsurface model for the entire surveyed area.
8. Prepare final correlated and interpreted cross-sections for each seismic line.

## **6.6 RESISTIVITY SURVEY PROCEDURES**

### **6.6.1 Introduction**

Resistivity techniques provide estimates of a fundamental earth parameter -resistivity -- as a function of electrode spacing and/or depth. The method consists of measuring the electropotential difference between two surface mounted electrodes (i.e. potential electrodes) caused by the insertion of a direct current into the ground by two other surface mounted electrodes (i.e. current electrodes). These measurements, when coupled with a "geometric factor" derived from the spatial relationship of the four electrodes involved permit calculation of an "apparent resistivity" value. By altering the spatial relation of these four electrodes from measurement to measurement of potential difference, it is possible to derive a function relating apparent resistivity with an electrode (usually current) spacing. The Schlumberger electrode configuration will be used for this investigation. This configuration will permit the apparent resistivity versus electrode spacing function to be converted to a true resistivity versus depth relationship by means of mathematical inversion procedures.

## 6.6.2 Survey Design

Electrical resistivity surveys will be performed along the lines used for the seismic refraction surveys. Electrical resistivity data will be used to evaluate the depth and thickness of stratigraphic units, locate perched water tables and other anomalous aquifer properties.

**6.6.2.1 Necessary Equipment.** The following is a list of the minimum equipment necessary to collect data from a resistivity survey:

- resistivity transmitter/receiver unit with power supply;
- two low resistance insulated cables of a length equal to three times the depth to be explored (current electrodes);
- two low resistance insulated cables of a length equal to the depth to be explored (potential electrodes);
- four to five (depending on the configuration) steel or copper electrodes, 1-1/2 inch in diameter and 2 feet in length;
- field note book;
- pens with non-water soluble ink;
- survey rod;
- two 300-foot cloth tapes;
- three 5-pound hammers; and
- supply of electrolyte solution (e.g. salt water).

### 6.6.2.2 Field Procedures

A standard field procedure for collecting resistivity data is described below.

Preliminary considerations include:

- Review existing and appropriate site, area, geologic and hydrologic information.
- Define known hazards that pose a threat to the safety of field personnel.
- Define the purpose and expectations of the subsurface investigation.
- Determine appropriate field parameters and electrode configuration.
- Assess the proximity of electrical storms (if any) and the potential danger to personnel and equipment.
- Assess the extent of surface moisture and rain and any consequent effect of leakage from surface cables.
- Survey and stake sounding stations and cable orientation.

A standard field procedure for collecting resistivity data is described below:

1. Perform visual survey along the potential cable orientation giving special attention to overhead power lines, buried cables and pipes that could interfere with the survey.
2. With tape measure, mark position of all electrode stations from the sounding location as predetermined by depth and resolution requirements of the survey.



3. For the first measurement station insert the four electrodes to a depth of 6 inches to ensure good electrical contact with the ground. Saturate the soil surrounding the electrode with an electrolyte solution, if necessary.
4. Connect electrodes to appropriate terminals on the resistivity transmitter/receiver unit by means of the insulated low resistance cables. Energize the current electrodes and measure the voltage drop across the potential electrodes as prescribed by the unit manufacturer. Note value in the field notebook. De-energize the current electrodes.
5. Proceed to the next station and repeat 3 and 4.
6. Continue as noted in 5 until last station is measured for the sounding location.
7. Proceed to the next sounding location and repeat 1 through 6.

### **6.6.3 Data Reduction and Interpretation**

A standard procedure for reducing and interpreting the resistivity data is described below:

1. Reduce voltage (potential) data to resistance values at each station.
2. Ascertain the geometric factor for the electrode configuration used and convert resistance values to apparent resistivity values for each station (or electrode spacing).
3. Plot resistivity versus electrode spacing data on log-log paper.
4. If required and the configuration permits, mathematically invert the apparent resistivity data to obtain true resistivity values as a function of depth. Tabulate results.

5. Correlate results with boring data if available.
6. Prepare vertical or horizontal iso-resistivity contour sections as may be required to enhance interpretation.
7. Correlate, compare and interpret data for the surveyed area.

## 6.7 DOWNHOLE GEOPHYSICAL LOGGING

### 6.7.1 Overview

Borehole (or "downhole") geophysical logging techniques collect information about the lithology and physical properties of geological formations from wells or borings. These geophysical techniques continuously measure physical properties along the entire length of a borehole, supplementing the discrete information from continuous split-spoon sampling. The techniques can provide a variety of data simultaneously, including water content, bulk density, dry density, and porosity of the strata. These measured properties allow interpretations of characteristic "signatures" for stratigraphic units, which can be used to correlate the units between boreholes.

### 6.7.2 Phase II Activities

A geophysical investigation will be performed as part of the Phase II physical characterization to define more completely the site stratigraphy and obtain measured physical properties of the lithology. A downhole logging survey is proposed as part of the geophysical investigation. Logging will be conducted in all new and existing deep monitoring wells, and also in some selected shallow monitoring wells. Nuclear logging techniques will be used because the methods are relatively unaffected by well casings. Three specific logging techniques are proposed:

- *natural gamma logging*, which measures the natural radioactivity of the formation and primarily identifies clay fractions;

- *gamma-gamma (density) logging*, which emits gamma radiation into the formation and measures bulk density; and
- *neutron logging*, which emits neutrons and measures the moisture content and porosity of the formation.

### 6.7.3 Logging Equipment

The equipment to be used for natural gamma logging, gamma-gamma logging, and neutron logging is described below.

#### Natural Gamma Logging Equipment

Natural gamma logging will be performed using a Mount Sopris model ALP 4979 instrument; the probe (which also measures electrical resistivity) has a diameter of 1.75 inches.

#### Gamma-Gamma (Density) Logging Equipment

Gamma-gamma logging will be performed using a Mount Sopris model HLP 4180 instrument; the probe (0.125 ci, Cs-137) contains a cesium source and has a diameter of 2.5 inches.

#### Neutron Logging Equipment

Neutron logging will be performed with a Mount Sopris model OLP 4676 instrument; the probe (1.0 ci, AMBe) contains an americium-beryllium source (which provides neutrons with initial energies of several million electron volts) and has a diameter of 2.0 inches.

### Other Equipment

All data will be recorded digitally on a Compaq II recorder (Colog).

#### **6.7.4 Field Requirements**

The borehole geophysical survey will be performed by qualified personnel. Field personnel conducting the downhole logging survey will be trained appropriately, and will possess valid licenses for the use of radioisotope sources. The field requirements for conducting the Phase II downhole logging survey are described below.

- Information about the hole quality and logging procedure will be recorded in the log header for each log.
- All logging probes will be tested and calibrated on a regular basis (as appropriate for each probe). Testing and calibration will be done according to the manufacturer's recommendations or in accordance with the guidelines presented in Hodge (1988). In addition, all logging probes will be field-checked at the beginning of each day of field work and re-calibrated as necessary. Calibration and field-check information will be recorded for the probe in the borehole log for that instrument.
- The logging speed for each borehole technique will be chosen based on the type of probe used, noise conditions, and data resolution requirements. Logging speeds will be recorded in the log header.
- The vertical scale will be the same for each log and will be chosen based on data resolution requirements.
- The horizontal scale for each log will be chosen to accommodate a reasonable range of signal variation. If the signal variation exceeds the expected range, or if accommodating the expected variation would degrade signal resolution, the log will be run at two scales: one scale will span the

entire range of variation, the other will show the necessary resolution (either for the entire log or for specific zones of interest, as appropriate).

- Log starting depths will be referenced to the surveyed top of riser for each well and recorded on the log header. The log header also will contain the well information, log information, and miscellaneous information.
- Before running any nuclear probe containing a radioisotope source, all other non-source logs will be run. The data from these logs, as well as any other pertinent information, will be used to assess the condition of the borehole. Nuclear probes containing radioactive sources will not be used when the existing borehole data indicate the possibility of entrapment of the probe within the borehole.

#### **6.7.5 Information Recorded**

The well information, log information, and miscellaneous information that will be recorded during downhole logging are described here.

##### Well Information

The following information will be recorded about each well logged in the survey:

- well name/number (the well identifier -- e.g., "MW-1D");
- location coordinates (using the Rhode Island Grid System);
- surface elevation (above mean sea level);
- casing height (above ground surface);
- depth reference (relative to the top of the well riser);
- borehole diameter;
- casing information (including type, diameter, and depth);
- construction information (including cement, filter pack, and screen); and
- drilling information (including date drilled, depth, and method).

### Log Information

The following information will be recorded during logging:

- type of log (e.g., gamma-gamma);
- run number;
- name(s) of operators (and observers, if any);
- date logged;
- probe description (manufacturer, model, and serial number);
- logging speed;
- recorder scale;
- module/panel settings;
- calibration data; and
- other logs run in the same hole (a listing).

### Miscellaneous Information

The following miscellaneous information also will be recorded during downhole logging:

- weather information;
- logging conditions;
- irregularities in calibration; and
- logging procedure.

## **6.8 FIELD NOTEBOOKS**

Hardcover bound field books will be used because of their compact size, durability, and secure page binding. The pages of the notebook will be numbered consecutively and will not be removed. Entries will be made in waterproof indelible ink.

Notebooks contain the documentary evidence for procedures as performed by field personnel. Each entry will be dated. Entries will be legible and contain accurate and complete documentation of the individual's or sampling team's activities. The level of

detail will be sufficient to explain and reconstruct the operation should legal proceedings require it. Each notebook page will be signed by all personnel making entries on that page. All field notebooks and records will be made available to USEPA or its contractors upon request.

A standard format will be used to assure that all necessary information is included. The following types of information will be provided for each sampling task as appropriate:

1. Project name and job number.
2. Reasons for being on site or taking the sample such as quarterly sampling, resampling to confirm previous analysis, initial site assessment, etc.
3. Date and time of sampling. Date and time of well bailing for ground water samples.
4. Sample identification number.
5. Geographical location of the sampling point with reference to site (or other) facilities or a map coordinate system (sketches are helpful).
6. Physical location of the sampling point such as depth below ground surface or water surface.
7. Description of the method of sampling including procedures followed, equipment used, and any departure from the procedures specified herein. Volume of water purged and water levels will be included for ground water samples.
8. Description of the sample including the type of sample (soil, sludge, water, etc.).

9. Results of field measurements such as conductivity, salinity, temperature, and pH.
10. Weather conditions at the time of sampling, and previous events that may affect the nature of a sample, for example, heavy rains prior to sampling impoundment waters.
11. Photographic information. Briefly describe what was photographed and why, the date and time, the compass direction of the picture, and the number of the negative on the roll.
12. Reference numbers from all serialized forms on which the sample is listed or labels which are attached to the sample, i.e., chain-of-custody forms, airbill numbers, etc.
13. Other pertinent observations such as the presence of other persons on the site (those associated with the job or members of the press, special interest groups, or passers-by), actions by others that may affect performance of site tasks, etc.
14. Names of sampling personnel and signature of persons making entries.

## **6.9 DECONTAMINATION PROCEDURES**

### **6.9.1 Overview of Decontamination Procedures**

Equipment and personnel decontamination areas will be set up in an area determined to be uncontaminated but as near as possible to the work site. Determination of the decontamination areas will be made using site reconnaissances or other determinative procedures. All decontamination of personnel and equipment will be performed in these designated areas only.



## **6.9.2 Personnel**

Decontamination of personnel is discussed in Volume 4 - Health and Safety Guidelines.

## **6.9.3 Heavy Equipment**

Decontamination of large drilling equipment, drilling tools (augers, rods, bits, etc.), and backhoe buckets will be performed to prevent cross-contamination of test pits and boreholes, especially those in which ground water monitoring wells will be established. Heavy equipment that may have contacted contaminated material will be cleaned before use by washing with potable hot water under high pressure.

## **6.9.4 Sampling Equipment**

All hand-operated water, soil and sediment sampling equipment will be decontaminated prior to use in the laboratory or in the field, or between samples. The following procedure will be used to decontaminate sampling equipment:

1. scrub with potable water to remove mud and residue;
2. scrub with a solution of non-phosphate detergent (Alconox) and water using a hard bristle brush;
3. rinse with distilled/deionized water;
4. rinse with pesticide-grade hexane;
5. rinse with distilled/deionized water; and
6. wrap equipment in aluminum foil to prevent contamination.

If samples to be collected will be analyzed for metals, then equipment will be rinsed with 10% Nitric Acid after step 3 and rinsed again with distilled/deionized water.

#### **6.9.5 Handling of Drilling Spoils, Fluids and Extracted Ground Water**

Solid drilling spoils will be temporarily stored on site until the results of soil analyses have been validated and evaluated. Subsequent handling of the spoils will be based on those results. For temporary storage, the spoils will be placed in bins. If analytical results of soil samples indicate that the spoils may need to be disposed of as hazardous waste, composite samples will be analyzed for TCLP.

## 7.0

### SAMPLE CUSTODY

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Chain-of-custody forms will be used to record history of possession of sample containers and, subsequently, samples. Samples will be considered in custody if they are within site of the individual responsible for their security or locked in a secure area. Field sampling personnel are responsible for sample security until they are turned over to the Sample Coordinator. Chain-of-custody forms will be initiated by the laboratory when they issue the sample containers. The forms will be maintained through sample bottle acquisition and sampling by sampling personnel, and will be returned to the laboratory upon submission of samples. Each person (except for couriers) taking possession of the samples will record their name along with the date and time of acquisition. Laboratory chain of custody will be maintained throughout the analytical processes as described in the Quality Assurance Manuals for each laboratory.

Sample information pertinent to their analysis will be recorded on the chain-of-custody form. The information will include a sample identification number, sampling location, date and time of sampling, sample preservatives, type and number of sample containers, and analyses to be performed.

Each sample will be labeled in the field. Information recorded on the label will include the sample identification number, time and date of sampling, sample preservative and analysis to be performed.

Entries on labels and forms will be made with permanent ink. Corrections will be made by placing a single line through the incorrect entry and will be initialed by the person making the correction.

Procedures for shipment of samples are summarized in Section 6.3.

## 8.0

### CALIBRATION PROCEDURES

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Equipment and instruments used to perform tests or record data will be calibrated prior to use. Documentation of calibration will be completed by the person performing the calibration.

The 1990 DCQAP presented calibration requirements for various instruments or equipment. In addition, to using those items previously described, other equipment will be used in the Phase II activities.

Manufacturer's operation manuals, including detailed calibration procedures are on file with the WCC Equipment Technician.

Preventative maintenance of equipment is described in Section 13 and field instrument standards are presented in Table 14-1.

#### 8.1 DOWNHOLE GEOPHYSICAL LOGGING

The equipment used to perform testing or record data will be calibrated prior to use as appropriate. Documentation about calibration will include identification of the specific device or instrument that was calibrated, the date it was calibrated, and the reference standard that was used. The calibration procedures for field equipment are summarized here; manufacturer's operation manuals, which include detailed calibration procedures, are on file with WCC.

Calibration of the logging probes (natural gamma, gamma-gamma, and neutron) will be accomplished as follows:

1. Originally, all three probes were calibrated in the University of Houston API test pit for natural gamma activity, density, and porosity.

2. Daily calibration will be performed in the field using the instrument's internal calibration mechanisms and procedures.
3. The probes are calibrated annually in a 360-foot open-hole well located at the Northwest Florida Water Management District. The logs are compared with those from the original calibration runs to verify the instruments' ability to replicate the signatures of the well.
4. Periodically, calibration blocks are used for calibrating the natural gamma and density probes.
5. In the field, duplicate logs will be run on about 10 percent of the wells to ascertain measurement reliability.

**9.0**

**ANALYTICAL PROCEDURES**

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Laboratory analytical procedures are included in QA Plans provided by each laboratory. Procedures for field analytical methods, equipment, and instruments are described in Section 6.0.

Calibration standards are identified in Table 14-1.

10.0

**DATA MANAGEMENT REDUCTION, VALIDATION AND REPORTING**

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The procedures and requirements for this Section as presented in the 1990 DCQAP have not changed significantly. Major changes are discussed below. During Phase II activities a Sample Coordinator will be responsible for the sample handling and documentation integrity which was formerly handled by Task Leaders.

Replicate sample concentrations may be averaged prior to further data reduction. These average concentrations may be presented in tables and graphs. Single concentrations may also be used if the reason for using the single or average concentration is presented in the report text for the table or graph.

Data validation of Phase II laboratory deliverables will use the checklists that were developed for Phase I validation. These data validation checklists, modified to address the Appendix IX constituents of the analytical program, are included as Attachment A.

11.0

**INTERNAL QUALITY CONTROL CHECKS**

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Internal quality control checks for field sampling techniques include field blanks, trip blanks and field duplicate samples.

The frequencies for collection and analysis of these samples presented in the 1990 DCQAP will remain the same for the Phase II activities. Field blanks will be collected at the rate of one per 20 samples collected of a given matrix. No field blanks will be submitted for samples analyzed for dioxins/furans. Trip blank samples will be analyzed at the rate of one per sample shipment.

It is the responsibility of the Field Manager and the Sample Coordinator to ensure that the appropriate samples are collected and sent to the laboratories to fulfill the frequencies indicated.

Overall project control is the responsibility of the Project Manager. Project control for internal QC checks includes the peer review of documents, reports, and other deliverables, audits and management of personnel.



## 12.0

### PERFORMANCE AND SYSTEMS AUDITS

---

This section has been revised to provide additional information on the types of audits to be conducted during Phase II activities.

Internal performance and system audits will be performed as appropriate throughout the duration of the Phase II Investigation Activities. The objectives of the performance and system audits are to ensure that the quality assurance program developed for this project is being implemented according to the specified requirements, to assess the effectiveness of the quality assurance program, to identify nonconformances, and to verify correction of identified deficiencies or nonconformances. If any significant deviations from the DCQAP are documented, corrective action measures will be implemented and documented as detailed in Section 15.0. Reports to be prepared at the completion of an audit are described in Section 16.0.

The QAO will be responsible for initiating audits, selecting the audit team, and overseeing audit implementation. The QAO will also report to the Project Manager the results of audits, and corrective action measures taken, if any.

#### 12.1 PERFORMANCE AUDITS

Performance audits are usually conducted after data management systems are operational and data is being collected. Performance audits are used to quantitatively assess the accuracy of the data. Performance audits consist of two types: internal and external.

##### 12.1.1 Internal

Internal performance audit check samples will be submitted by WCC to the subcontracted laboratories. These samples will consist of blanks and duplicates as described in Section 11.0. Additional sample volume is collected by WCC and sent to the laboratory for use as MS/MSD samples. Analytical results from these internal

performance audit samples will be used throughout the project to assess data from environmental samples for accuracy and precision.

#### **12.1.2 External**

External performance audit check samples are samples submitted by external regulatory agencies to assess whether a contractor's laboratory is generating data within acceptable control limits. If external performance audit check samples are provided by EPA, the subcontracted laboratory will analyze these samples and provide analytical results along with results of the investigation samples.

### **12.2. SYSTEMS AUDITS**

Systems audits will be conducted during the Phase II investigation activities in order to verify that quality control measures/procedures specified in the DCQAP are being used, documentation and project records are being completed and maintained, and that reviews of documents and reports are being conducted.

### **PHASE II GENERAL AUDIT**

Prior to the initiation of field activities, an audit will be conducted by the QAO of all project-related activities to ensure compliance with the Phase II Proposal and DCQAP Supplement by personnel performing the work. This audit will be a general audit with primary emphasis on verification of communication and coordination between the key personnel identified in Section 2.0. This audit will be conducted with the Project Manager and field team personnel. Any non-conformances or revisions to the Phase II proposal or DCQAP will be documented and addressed by the Project Manager and QAO prior to initiation of field activities.

### **12.2.2 Field System Audit**

A field system audit will be conducted by the QAO or qualified designee during the initial Phase II sampling activities. The audit will include an on-site review of field operations, facilities, and activities, including sampling and equipment use and calibration. Documentation such as field notes, chain-of-custody forms, and equipment calibration forms will be checked for completeness and conformance to the DCQAP requirements.

The auditor will provide an oral report summarizing the results of the audit to the Project Manager within five working days of the audit. A written report documenting all activities associated with the field system audit will be provided to the Project Manager within twenty working days after completion of the audit. The report will document audit findings, on-site meetings, and program revisions, if necessary. A follow-up or second audit will be conducted if the Project Manager deems it necessary, or if field activities continue beyond 6 months.

### **12.2.3 Laboratory System Audit**

A laboratory systems audit may be conducted by the QAO (or qualified designee) or CIBA-GEIGY during analysis of initial sample shipments sent to the laboratory. If a laboratory systems audit is conducted, the auditor, in conjunction with the Project Manager representing the subcontracted laboratory, would ensure that documentation is available to verify that instrumentation required are being used in the analysis of samples, and that the instruments are functioning properly. This initial audit would also include a review of the analytical methods proposed for use and the laboratory SOPs prepared from these methods. The laboratory project manager or his/her designee would make changes as necessary following the initial laboratory systems audits.

#### **12.2.4 Office System Audit**

Office system audits will be conducted as part of the overall Quality Assurance Program. The office audit consists of reviewing the project file and verifying that data collected is being presented, reviewed, and filed in accordance with this DCQAP and an established in-house WCC Program. The WCC auditor will be responsible for conducting office system audits of this project semi-annually. The auditor will notify the QAO in writing of the audit findings within twenty working days of the audit. The QAO will present the findings to the Project Manager if further action is required.

In addition, the QAO will conduct a limited office audit immediately prior to the start of field activities. The audit will focus on review of the established project filing system and procedures and requirements for documentation. This audit will help ensure that the project file and documentation system are set-up in a manner which will facilitate information and data storage and retrieval during the Facility Investigation.

#### **12.3 AUDIT RECORDS**

Original records generated for all audits shall be retained within project files. Records shall include audit reports, the record of the implementation and completion of corrective actions, and documents associated with the audits which support audit findings and corrective actions as appropriate.

13.0

**PREVENTIVE MAINTENANCE**

---

Preventive maintenance of field equipment and measurement devices will be performed by the WCC Equipment Technician and by the field personnel using the equipment. Table 13-1 is updated to include additional equipment for Phase II activities.

Maintenance of major equipment, such as that used in soil gas surveys or geophysical logging will be conducted as specified by the manufacturer's recommendations or by the manufacturer. This will be the responsibility of the personnel using the equipment.

The WCC Equipment Technician has access to critical spare parts and additional pieces of equipment. Backup equipment will be delivered to the field personnel in a timely fashion so that downtime due to equipment failure will be kept to a minimum.

**14.0**

**SPECIFIC PROCEDURES USED TO ASSESS DATA PRECISION,  
ACCURACY AND COMPLETENESS**

---

The protocols and procedures presented in the 1990 DCQAP are essentially unchanged. Data validation procedures are also discussed in Section 10.0. Revised data validation checklists are presented in Attachment A to reflect changes by the new laboratories performing the analyses.

## 15.0

### NONCONFORMANCE AND CORRECTIVE ACTION

---

This section has been amended to include additional information for addressing out-of-control situations (nonconformances) and the mechanism for corrective action. Procedures for notifying responsible personnel of nonconformance and corrective action are also modified to include the CIBA-GEIGY Project Coordinator. WCC will report these items directly to the CIBA-GEIGY Project Coordinator on a semi-annual basis or as directed by the Project Coordinator.

The ultimate responsibility for maintaining quality throughout the project rests with the Responsible Professional and the QAO. The routine operation of the quality assurance program, however, falls upon the Project Manager, the QAO, the technical staff, and the subcontracted laboratory's Quality Assurance Officers and Project Managers.

Any member of the project staff who identifies a condition adversely affecting quality can initiate corrective action by notifying the Responsible Professional, Project Manager or QAO. A written communication identifying the condition and an explanation of how it may affect data quality or quantity is preferable for initiating the corrective action process.

#### 15.1 NONCONFORMANCE

A nonconformance is an unauthorized deviation from documented procedures, practices or standards, or a defect in an item that is sufficient to render the quality of the item unacceptable or indeterminate, or any event which is beyond the expected conditions and limits such as those presented in this DCQAP. Nonconformances may include (but are not limited to) the following:

- failure of an instrument to work properly;
- sample documentation not correct;

- sample holding time exceeded;
- sample storage conditions outside criteria;
- incorrect sample preparation/analysis procedures used;
- Quality Control sample data (replicate, duplicate, blind duplicate, etc.) outside limits;
- calibration requirements not met;
- documentation errors in data recording or transcription;
- data validation errors;
- a recovery or RPD result that is out of control limits (e.g., more than three standard deviations from the weighted mean);
- relative standard deviation for response factors greater than accepted limits; and/or
- any situation or result which might affect the quality of data.

Any identified nonconformances with the established quality control procedures will be expeditiously controlled or corrected. Additional work which is dependent on the nonconforming activity will not be performed until the identified nonconformance is corrected.

## **15.2 CORRECTIVE ACTION**

A corrective action is an appropriate measure applied to correct a nonconformance and minimize the possibility of recurrence. Corrective action may be necessary in the event



that data is determined to be suspect following performance or system audits or when existing or potential conditions are identified which may have an adverse impact on data quality.

#### **15.2.1 Field Corrective Action**

The Project Manager will periodically review the procedures being implemented in the field and audit findings, if available, for verifying consistency with the established procedures and protocols. Sample collection, preservation, and labeling, etc., will be checked for completeness. Where procedures are not strictly in compliance with the established protocol, deviations will be documented and reported. Corrective actions will be defined by the Project Manager and QAO and documented as appropriate. Upon implementation of the corrective action, the QAO will provide the Program Manager with a written memo documenting field implementation. The memo will become part of the project file.

#### **15.2.2 Laboratory Corrective Action**

The laboratory's Quality Assurance Officer and the project Data Validator(s) will review the analytical data generated to ensure that all quality control samples have been run as specified in the protocol. Recoveries of spike samples will be checked for consistency with method accuracy and duplicate samples will be checked with method precision. Where sample results fall outside of the acceptable ranges, deficiencies will be reported to the Project Manager and CIBA-GEIGY NSCA. Corrective actions will be defined by the Project Manager in coordination with the NSCA and the Laboratory Project Manager and documented as appropriate.

Laboratory personnel may be notified that corrective actions may be necessary if:

- QC data are outside the warning or acceptable windows for precision and accuracy as established for matrix spikes and matrix spike duplicates in the

analytical protocols.

- Method blanks contain contaminants at concentrations above the required quantitation limit of any target compound.
- Undesirable trends are detected in matrix spike recoveries or coefficients of variation (CV) between matrix spike duplicates.
- There are unusual changes in detection limits.
- Deficiencies are detected during internal or external audits, or from the results of performance evaluation samples.

Additional requirements for laboratory corrective action are specified in QA Manuals for each laboratory and by CIBA-GEIGY.

**16.0**

**QUALITY ASSURANCE REPORTING PROCEDURES**

---

The requirements and procedures for reporting QA information, data, and findings are discussed in Section 12.0 for audits, Section 10.0 for most data, and Section 15.0 for corrective action.

Changes and modifications, including deviations and nonconformances to the DCQAP will be managed by the QAO in conjunction with the Project Manager.

Reporting of audit results and conformances which do not change the overall scope of work for Phase II activities will be handled routinely as described in Section 15.0. For nonconformances which are significant deviations or out-of-control situations, the QAO will verbally discuss them with the Project Manager immediately upon determination of the situation. A written report will be issued within 10 working days to the CIBA-GEIGY Project Coordinator.

If pages or sections of the DCQAP require modification due to a corrective action, the QAO and Project Manager will coordinate the revision of the proper pages or sections and will distribute them to the recipients of the DCQAP Supplement for incorporation into their document copy.

17.0

### LIST OF CURRENT PERSONNEL FOR KEY POSITIONS

---

The following is a list of the current WCC personnel which hold key positions for the Phase II activities.

Responsible Professional (RP)	Roger J. Henning
Project Manager (PM)	Mark Houlday
Site Manager (SM)	Edward M. Hastings
Project Administrator (PA)	Martin M. Sklaver
Health and Safety Officer	Erick Sepulveda
Project Quality Assurance Officer (QAO)	Marion E. Craig
Sample Coordinator (SC)	Kenneth A. Kievit
Quality Assurance Coordinator (QAC)	Edward M. Hastings

This list may be modified during the course of Phase II work.

18.0

**LIST OF CHANGES TO THE DCQAP**

---

This section will incorporate a summary of all changes to the DCQAP. If pages or sections of the DCQAP require revision, the following information will be presented in this section:

- date of revision;
- pages or sections affected by revision;
- description of the revision with a brief description of the reason for instituting the modification; and,
- reference to the proper nonconformance and corrective action reports.

The revised pages or sections will be issued to the recipients of the DCQAP Supplement along with the revised Section 18.0. This will be issued by the QAO and Project Manager.

**TABLE 5-1**  
**SUMMARY OF FIELD MEASUREMENT QUALITY ASSURANCE OBJECTIVES**

Field Measurement (method)	Instrument	Precision (standard deviation)	Accuracy	Reporting Units
pH (electrometric)	Hach Model 1	$\pm 0.50$ pH units	$\pm 0.10$ pH units	Standard units
Conductivity (electrometric)	YSI Model 33 SCT Meter	$\pm 5.0\%$ of scale	$\pm 10\%$ of standard	umhos/cm
Temperature (electrometric)	YSI Model 33 SCT Meter	$\pm 1.0^{\circ}\text{C}$	$\pm 0.5^{\circ}\text{C}$	degrees Centigrade
Organic vapors (photoionization detector)	HNU Model PI-101	Not applicable because of dynamic conditions	$\pm 2$ ppm of standard	parts per million
Water level (electrometric)	Solinst Model 101	$\pm 0.10$ ft	$\pm 0.02$ ft	feet
Water Pressure (electrometric)	Hermit data logger 10 psi transducer 50 psi transducer	Not applicable because of dynamic conditions	$\pm 0.05$ ft $\pm 0.23$ ft	feet feet
Organic Vapors (flame ionization detector)	OVA Model 128	Not applicable because of dynamic conditions	$\pm 2$ ppm of standard	parts per million
Dissolved Oxygen	YSI Model 58	$\pm 0.20$	$\pm 0.03$ ppm	parts per million

**TABLE 5-1 (continued)**  
**SUMMARY OF FIELD MEASUREMENT QUALITY ASSURANCE OBJECTIVES**

Field Measurement (method)	Instrument	Precision (standard deviation)	Accuracy	Reporting Units
Alkalinity	HACH Digital Titration Meter 16900-01	±1 ppm	±0.1 ppm	parts per million
Sulfide	HACH Hydrogen Sulfide Test Paper 393-33	Not applicable because of dynamic conditions	±0.2 ppm	parts per million
Ground Penetrating Radar	Geophysical Survey Systems SIR System 8	NA	NA	nannoseconds
Resistivity	ABEM Terrameter SAS 300	NA	±2% of reading +2 digital increments	ohms
Refraction	Geometrics ES1210 -or- Bison Geopro 8012A	NA	milliseconds	ohms

NOTES:

psi	=	pounds per square inch
umhos/cm	=	micromhos per centimeter
*	=	scales covers three ranges: 0-500; 0-5,000; and 0-50,000 umhos/cm
NA	=	not available

**TABLE 13-1**  
**PREVENTIVE MAINTENANCE REQUIREMENTS**

<u>Instrument</u>	<u>Items Checked/Service</u>	<u>Frequency</u>
pH meter - Hach - Model 1	batteries checked replace saline solution	when issued and each day of use as needed
Conductivity meter - YSI Model 33	batteries checked serviced by manufacturer only	when issued and each day of use as needed
Temperature meter - YSI Model 33	batteries checked serviced by manufacturer only	when issued and each day of use as needed
Dissolved Oxygen Meter - YSI Model 58	batteries checked membrane checked	when issued and each day of use as needed
pH, Conductivity, Dissolved Oxygen Meter - Corning Checkmate	batteries checked membrane checked	when issued and each day of use as needed
Organic vapor meter - HNU - Model PI-101	battery pack and lamp checked clean lamp replace lamp	when issued and each day of use as needed as needed
Organic vapor meter - OVA - Model 128	battery pack checked hydrogen supply checked serviced by manufacturer only	when issued and each day of use when issued and each day of use as needed
Water level meter - Solinst - Model 101	batteries checked	when issued and each day of use
Automated Data Logger - Hermit Model SE 2000	storage endurance checked serviced by manufacturer only	when issued and each day of use as needed
Single-Channel Automated - Aquistar DL/1A Data Logger	rechargeable battery memory capacity dessicant chamber inserts	replaced monthly replaced monthly replaced monthly



**TABLE 14-1**  
**FIELD INSTRUMENT STANDARDS**

<u>Instrument</u>	<u>Standard</u>
pH meter	pH 1.01, 7.00 and 10.00 powder pillows supplied by HACH Co.
Conductivity meter	85.47 and 1000 mg/L NaCl solutions supplied by HACH Co.
Dissolved Oxygen meter	Zero oxygen solution and air
Thermometer	NBS thermometer
Turbidimeter	5.00 and 60.0 polymeric standards
HNU	isobutylene supplied by Instrument Services, Inc.
OVA	Methane and zero air
Water level meter	Calibrated steel tape
Hermit data logger	Calibrated steel tape

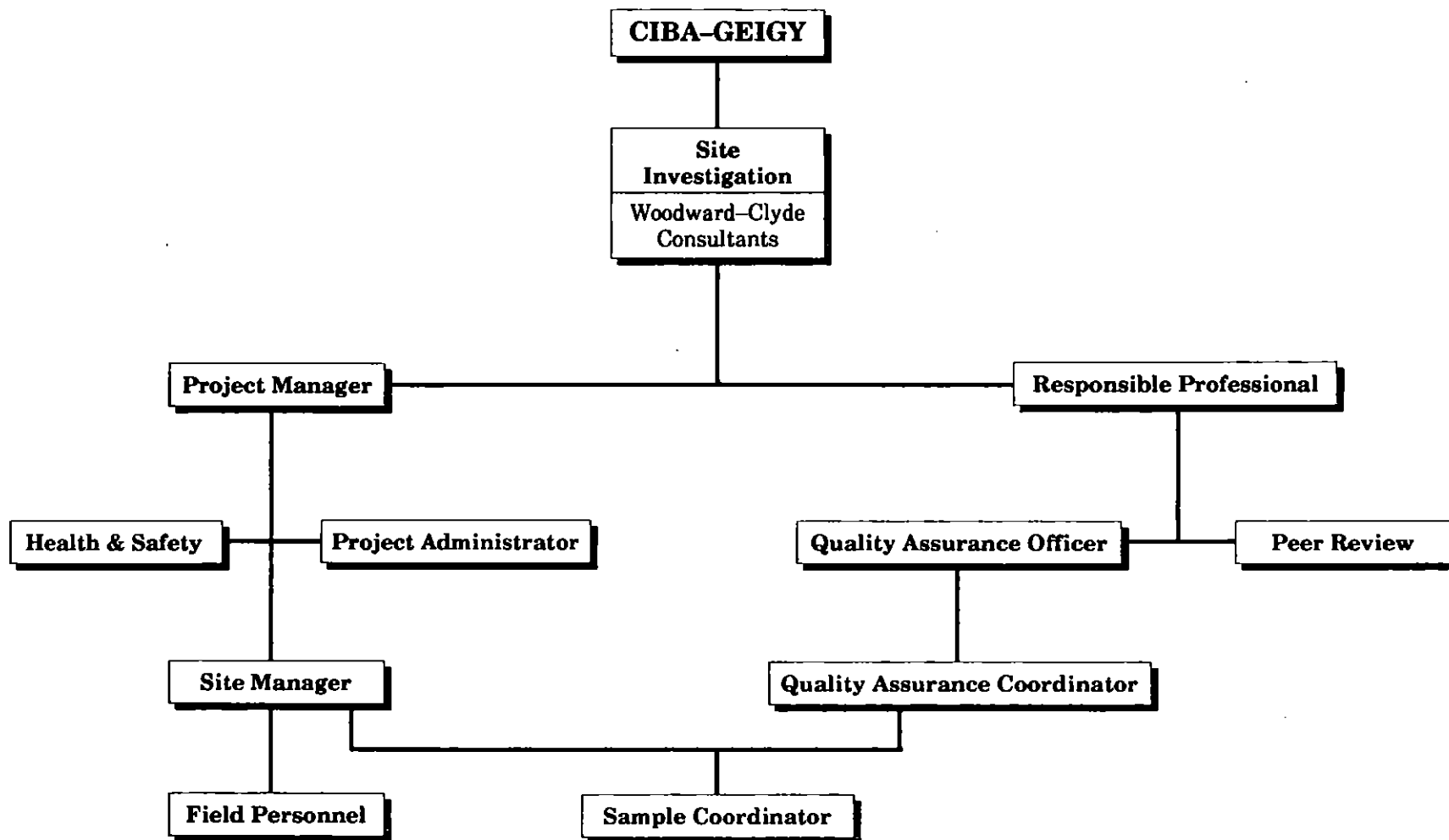


Figure 4-1

**Project Organization  
CIBA-GEIGY Facility  
Cranston, Rhode Island**

## **Attachment A**

**ORGANIC ANALYSES**  
**LABORATORY DATA REVIEW**  
**USEPA REGION I WORKSHEETS**  
**EDITED FOR APPENDIX IX COMPOUNDS**  
**REVISION I**

**Prepared by:**

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**JANUARY 1992**

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## PESTICIDE/PCB ANALYSIS

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**CIBA-GEIGY**  
**ORGANIC REGION I WORKSHEET BACKGROUND**

---

External Laboratories have been contracted by CIBA-GEIGY to analyze the hazardous constituents in Appendix IX and the site-specific fingerprint compounds. The labs will be utilizing USEPA Publication SW-846 (Third Edition) procedures and the Contract Lab Program (CLP) 12/90 Statement of Work (SOW) (for dioxins and furans) listed in Table 1 on the following page. As such, the enclosed USEPA Region I Data Validation Worksheets for Organic Analyses have been modified accordingly for the Appendix IX Analytes to conform to the QA/QC criteria of each test method in Table 1.

This revision of the worksheets was due to two main factors:

1.     Reevaluation of acceptance criteria due to a change in laboratories for this Project. The prior worksheets were based on Radian specific information. These worksheets have been revised to be applicable to the following labs for Appendix IX (non-dioxins):

Savannah Laboratories, Inc. and PACE, Inc.

for Appendix IX dioxins and furans:

Triangle Labs of Houston and Enseco-CAL

2.     Reevaluation of criteria due to change in dioxin/furan method from 8280 to CLP SOW (12/90) for PCDD and PCDFs.

**TABLE 1**  
**SELECTED ANALYTICAL METHODS FOR**  
**ORGANIC APPENDIX IX ANALYSES**

SW-846 Method	General Category/ Analyte	Technique	Radian	Number of Analytes Measured			ENSECO CAL
				Savannah	PACE	Triangle Houston	
8080	Organochlorine Pesticides and PCBs	GC/ECD	29	30	29		
8140/8141	Organophosphorus Pesticides	GC/FPD	9	8	8		
8150/8151	Herbicides	GC/ECD	4	3	4		
8240	Volatile Organics	GC/MS	55*	55	55		
8270	Semivolatile Organics**	GC/MS	110★	111	112		
8280	Dioxins and Furans	GC/MS	7	0	X	21Δ	21Δ
TOTAL			214	207	208		

GC/ECD        -        Gas Chromatography/Electron Capture Detection  
GC/FPD        -        Gas Chromatography/Flame Photometric Detection  
GC/MS        -        Gas Chromatography/Mass Spectrometry

\*\*        This number includes Appendix IX analytes and site specific compounds.

★        Number of analytes corrected from the 2/91 Data Vd

\*        This number includes the 3 volatile analytes which were analyzed by direct injection GC/MS.



**REGION I REVIEW OF ORGANIC  
CONTRACT LABORATORY DATA PACKAGE**

The hardcopied (laboratory name) \_\_\_\_\_ data package received at WCC has been reviewed and the quality assurance and performance data summarized. The data review included:

Matrix:

No. of Samples:

Trip Blank No.:

Equipment Blank No.:

Field Dup Nos.:

Sampling Date(s):

Shipping Date(s):

Date Rec'd by Lab:

Sample Identifiers:

SW-846 (3rd Edition) requires that specific analytical work be done. The general criteria used to determine the performance were based upon an examination of:

- |                       |                                |
|-----------------------|--------------------------------|
| -Data Completeness    | -Matrix Spike/Matrix Spike Dup |
| -Holding Times        | -Field Duplicates              |
| -GC/MS Tuning         | -Internal Standard Performance |
| -Calibrations         | -Pesticide Inst. Performance   |
| -Blanks               | -Compound Identification       |
| -Surrogate Recoveries | -Compound Quantification       |

Overall Comments:

Definitions and Qualifiers:

- J - Approximate data due to quality control criteria.  
R - Reject data due to quality control criteria.  
U - Compound analyzed but not detected.

Reviewer:

Date:

REGION I  
Data Review Worksheets

**I DATA COMPLETENESS**

MISSING INFORMATION

DATE LAB CONTACTED

DATE REC'D

REGION I  
Data Review Worksheets

**II. HOLDING TIMES**

Complete table for all samples and circle the fractions which are not within criteria.

---

SAMPLE ID	DATE SAMPLED	VOA	BNA		PEST	
		DATE ANAL	DATE EXTR	DATE ANAL	DATE EXTR	DATE ANAL

---

In accordance with Table 4-1 of Section 4.0 SW-846 and EPA Region I protocols the holding time criteria and action levels are:

VOA - Unpreserved: Aromatic within 7 days, non-aromatic within 14 days of sample collection.  
Preserved: Both within 14 days of sample collection.  
Soils: Both within 14 days of sample collection.

BNA & PEST - Water: Extracted within 7 days, analyzed within 40 days.  
Soils (Solids): Extracted within 14 days, analyzed within 40 days.

**ACTION:** 1. If holding times are exceeded, all positive results are estimate (J) and non-detects are estimated (UJ).  
2. If holding times are grossly exceeded, the reviewer may determine that non-detects are also unusable(\*).

REGION I  
Data Review Worksheets

III. GC/MS TUNING

\_\_\_\_\_ The DFTPP performance results were reviewed and found to be within the specified criteria.

\_\_\_\_\_ If no,  
Samples affected:

\_\_\_\_\_ The BFB performance results were reviewed and found to be within the specified criteria.

\_\_\_\_\_ If no,  
Samples affected:

If mass calibration is in error refer to the Region guidelines for expanded criteria. If necessary, qualify all associated data as unusable (R).

Note: The BFB and DFTPP tune criteria for CLP and SW846 protocols are the same.

REGION I  
Data Review Worksheet

IV A. VOLATILE CALIBRATION VERIFICATION

Date of Initial Calibration:  
Dates of Continuing Calibrations:  
Instrument ID:  
Matrix/Level:

<u>DATE</u>	<u>CRITERIA OUT</u> <u>RF,%RSD,RF,%D</u>	<u>COMPOUND (VALUE)</u>
_____	Samples Affected:	
_____	Samples Affected:	
_____	Samples Affected:	
_____	Samples Affected:	
_____	Samples Affected:	
_____	Samples Affected:	
_____	Samples Affected:	
_____	Samples Affected:	
_____	Samples Affected:	
_____	Samples Affected:	

1. All RF's must be  $>0.05$
2. All %RSD's must be  $<30\%$
3. All %D's must be  $<25\%$

**ACTION:**

1. If any compound has an initial RF or a continuing RF of  $<0.05$ :
  - a. Flag positive results for that compound as estimated (J).
  - b. Flag non-detects for that compound as unusable (R).
2. If any compound has a %RSD  $>30\%$  or a %D  $>25\%$  for volatiles and  $>30\%$  for semivolatiles:
  - a. Flag positive results for that compound as estimate (J).
  - b. Flag non-detects for that compound as estimated (UJ) if the %RSD or %D is  $>50\%$ .

A separate worksheet should be filled out for each initial curve.

REGION I  
Data Review Worksheet

IV B. SEMIVOLATILE CALIBRATION VERIFICATION

Date of Initial Calibration :  
Dates of Continuing Calibrations :  
Instrument ID :

<u>DATE</u>	<u>CRITERIA OUT</u> RF,%RSD,RF,%D	<u>COMPOUND (VALUE)</u>
_____	Samples Affected:	
_____	Samples Affected:	
_____	Samples Affected:	
_____	Samples Affected:	
_____	Samples Affected:	
_____	Samples Affected:	
_____	Samples Affected:	
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_____	Samples Affected:	
_____	Samples Affected:	
_____	Samples Affected:	

See worksheet IV-A for criteria and actions.

A new worksheet should be filled out for each initial curve.

REGION I  
Data Review Worksheet

**V A. BLANK ANALYSIS RESULTS (Sections 1 & 2)**

List the contamination in the blanks below.

1. Laboratory Blanks

CONCENTRATION LEVEL: \_\_\_\_\_ (low or medium)\*

<u>DATE</u>	<u>LAB ID</u>	<u>FRACTION/ MATRIX</u>	<u>COMPOUND</u>	<u>CONCENTRATION/ UNITS</u>
-------------	---------------	-----------------------------	-----------------	---------------------------------

2. Equipment (Field) and Trip Blanks

<u>DATE</u>	<u>LAB ID</u>	<u>FRACTION/ MATRIX</u>	<u>COMPOUND</u>	<u>CONCENTRATION/ UNITS</u>
-------------	---------------	-----------------------------	-----------------	---------------------------------

.A separate worksheet should be used for low and medium level blanks.

REGION I  
Data Review Worksheets

V B. BLANK ANALYSIS RESULTS (Section 3)

3. Blank actions

Action levels should be based upon the highest concentration of contaminant determined in any blank. The action level for samples which have been concentrated or diluted should be multiplied by the concentration/dilution factor. No positive sample result should be reported unless the concentration of the compound in the sample exceeds the action level of 10 x's the amount for any other compound. Specific actions are as follows:

1. The concentration is less than the PQL, report the PQL.
2. The concentration is greater than the PQL, but less than the action level, report the concentration found with the U qualifiers.
3. The concentration is greater than the action level, report the concentration unqualified.

For examples refer to the Regional Guidelines.

Common contaminants = methylene chloride, acetone, 2-butanone, toluene, and phthalate ester compounds (i.e., bis(2-ethylhexyl)phthalate).

LEVEL: \_\_\_\_\_

<u>COMPOUND</u>	<u>MAX. CONC./</u> <u>UNITS</u>	<u>ACTION LEVEL/</u> <u>UNITS</u>	<u>PQL</u>
-----------------	------------------------------------	--------------------------------------	------------

A separate worksheet should be used for low and medium level blanks.



## VI. SURROGATE SPIKE RECOVERIES

List the percent recoveries which do not meet the criteria for surrogate recovery.

Matrix: \_\_\_\_\_

SAMPLE ID #'S	TOL**	VOA 4-BFB	DCE**	NBZ**	B/N FBP**	TPH**	PHL	A 2FP**	TBP**
------------------	-------	--------------	-------	-------	--------------	-------	-----	------------	-------

QC Limits	88	86	76	35	43	33	10	21	10
	to	to	to	to	to	to	to	to	to
(WATERS)	<u>110</u>	<u>115</u>	<u>114</u>	<u>114</u>	<u>116</u>	<u>141</u>	<u>110</u>	<u>110</u>	<u>123</u>

---

(SOLIDS)	<u>84</u>	<u>59</u>	<u>70</u>	<u>23</u>	<u>30</u>	<u>18</u>	<u>24</u>	<u>25</u>	<u>19</u>
	to	to	to	to	to	to	to	to	to
	<u>138</u>	<u>113</u>	<u>121</u>	<u>120</u>	<u>115</u>	<u>137</u>	<u>113</u>	<u>121</u>	<u>122</u>

\*\* CLP derived limits (CLP-Organic SOW: 3/90, current revision). This is a reference change from Radian lab derived limits except for 2 fluorophenol which had a maximum recovery limit of 100%.

Surrogate Actions:

### PERCENT RECOVERY

<u>Condition</u>	<u>&lt;10%</u>	<u>10%-(MIN)</u>	<u>&gt;R(MAX)</u>
Positive sample results	J	J	J
Non-detected results	R	UJ	No Action

R(MIN): Denotes the lower QC limit of the surrogate percent recovery range.

R(MAX): Denotes the upper QC limit of the surrogate percent recovery range.

Surrogate action should be applied:

1. If at least two surrogates in a B/N or A fraction or one surrogate in the VOA fraction are out of specification, but have recoveries of >10%.
2. If any one surrogate in a fraction shows <10% recovery.

**VII A. MATRIX SPIKE/MATRIX SPIKE DUPLICATE**

**1. Matrix Spike/Matrix Spike Duplicate Recoveries and Precision**

MS/MSD Pair Sample ID #'s \_\_\_\_\_, \_\_\_\_\_ Level: \_\_\_\_\_ Matrix: \_\_\_\_\_

List the percent recoveries and RPD's of compounds which do not meet the criteria stated in SW-846. USEPA 3/90 SOW guideline for percent recoveries and RPD maximums on the standard EPA Form III will be used for evaluation of data.

<u>FRACTION/ MS OR MSD</u>	<u>COMPOUND</u>	<u>% REC/RPD</u>	<u>QC LIMITS</u>
--------------------------------	-----------------	------------------	------------------

QUALIFICATION IS LIMITED TO THE UNSPIKED SAMPLE ONLY.

1. If any compound does not meet the recovery range, follow the actions stated below:

<u>Condition</u>	<u>PERCENT RECOVERY</u>		
	<u>&lt;10%</u>	<u>10%-R(MIN)</u>	<u>&gt;R(MAX)</u>
Positive sample results	J	J	J
Non-detected results	R	No Action	No Action

R(MIN): Denotes the lower QC limit of matrix spike recovery range.

R(MAX): Denotes the upper QC limit of matrix spike recovery range.

2. If any compound does not meet the RPD criteria, flag positive results for that compound as estimated (J).

A separate worksheet should be used for each MS/MSD pair.

Refer to Appendix A for tabulated matrix spike percent RPD maximums and percent recoveries.

REGION I  
Data Review Worksheets

VII B. MATRIX SPIKE/MATRIX SPIKE DUPLICATE (Section 2)

3. Matrix Spike Duplicate - Unspiked Compounds

MS/MSD Pair Sample ID #'s \_\_\_\_\_, \_\_\_\_\_

List the concentrations of the unspiked compounds and determine the percent RSD's of the unspiked sample, matrix spike, and matrix spike duplicate. No limits have been developed for the RSD values of the unspiked compounds.

<u>FRACTION</u>	<u>COMPOUND</u>	<u>SAMPLE, MS, MSD CONC.</u>	<u>%RSD</u>
-----------------	-----------------	------------------------------	-------------

The reviewer must use professional judgment to determine if there is a need to qualify any of the unspiked compounds in the sample.

**VIII. FIELD DUPLICATE PRECISION**

Field Dupliate Pair Sample ID #'s \_\_\_\_\_, \_\_\_\_\_ Matrix: \_\_\_\_\_

List the concentrations of the compounds which do not meet the following RPD criteria:

1. An RPD of <30% for water duplicates.
2. An RPD of <50% for soil duplicates.

<u>FRACTION</u>	<u>COMPOUND</u>	<u>SAMPLE CONC</u>	<u>DUP SAMPLE CONC</u>	<u>RPD</u>
-----------------	-----------------	--------------------	------------------------	------------

**ACTIONS:**

1. If the results for any compounds do not meet the RPD criteria, flag the positive results for that compound as estimated.
2. If one value is non-detected, and one is above the PQL:
  - a. Flag the positive result as estimated (J).
  - b. Flag the non-detected result as estimated (UJ).

**NOTE:** Professional judgment may be utilized to apply duplicate action to all samples of a similar matrix.

A separate worksheet should be filled out for each field duplicate pair.

## IX. INTERNAL STANDARD PERFORMANCE

List the internal standard areas of samples which do not meet the criteria of +100% or -50% of the internal standard area in the associated continuing calibration standard.

<u>SAMPLE ID</u>	<u>DATE</u>	<u>IS OUT</u>	<u>IS AREA/ RT</u>	<u>ACCEPTABLE RANGE</u>	<u>ACTION</u>
------------------	-------------	---------------	------------------------	-------------------------	---------------

### ACTION:

1. If an IS area count is outside the criteria -50% or +100% of the associated standard:
  - a. Positive results for compounds quantitated using that IS are flagged as estimated (J) for that sample fraction.
  - b. Non-detects for compounds quantitated using that IS are flagged as estimated (UJ) for that sample fraction.
  - c. If extremely low area counts are reported, or if performance exhibits a major drop-off, then a severe loss of sensitivity is indicated. Non-detects should then be flagged as unusable (R).
2. If an IS retention time varies more than 30 seconds, the chromatographic profile for that sample must be examined to determine if any false positives or negatives exist. For shifts of a large magnitude, the reviewer may consider partial or total rejection of the data for that sample fraction.

REGION I  
Data Review Worksheets

**X      A      PESTICIDE INSTRUMENT PERFORMANCE (Section 1)**

**1.      DDT Retention Time**

List the DDT standards which have a retention time (RT) of less than 12 minutes on the packed column (except OV-1 or OV-101).

<u>STANDARD ID</u>	<u>DATE/TIME</u>	<u>RT</u>	<u>SAMPLES AFFECTED</u>	<u>ACTION</u>
--------------------	------------------	-----------	-------------------------	---------------

Note: A megabore or capillary column standard RT may be shorter than 12 minutes. The laboratory must indicate the reasoning within the supplied Laboratory Case Narrative. If not, the data reviewer must contact the laboratory for the reason.

**ACTION:**

If the RT is less than 12 minutes, examine the chromatography to evaluate the separation. If adequate separation is not achieved, flag all affected compound data as unusable (R).

## REGION I

**X B. PESTICIDE INSTRUMENT PERFORMANCE (Section 2)**

## 2. Retention Time Windows

<u>COMPOUND</u>	<u>DATE</u> <u>(TIME)</u>	<u>RT</u>	<u>RT WINDOW</u>	<u>SAMPLES AFFECTED</u>
-----------------	------------------------------	-----------	------------------	-------------------------

mds\87x4660\d011mis.w51

REGION I  
Data Review Worksheets

X C. PESTICIDE INSTRUMENT PERFORMANCE (Section 3)

3. DDT and Endrin Degradation

List the standards which have a DDT or Endrin breakdown of greater than 20%.

STANDARD ID	DDT OR ENDRIN	PERCENT BREAKDOWN	SAMPLES AFFECTED	DDD, DDE OR ENDRIN KETONE PRESENT
----------------	------------------	----------------------	------------------	---

If the percent breakdown for DDT is greater than 20%:

1. Flag all positive results for DDT as estimated (J) for all samples following the last in control standard. If no DDT was present, but DDD and/or DDE are positive, then flag the quantification limit for DDT as unusable (R).
2. Flag all positive results for DDD +/- DDE as estimated (J).

If the percent breakdown for Endrin is greater than 20%:

1. Flag all positive results for endrin as estimated (J) for all samples following the last in-control standard. If no endrin was detected, but endrin aldehyde and/or endrin ketone are positive, flag the quantification limit for endrin as unusable (R).
2. Flag all positive results for endrin ketone as estimated (J).



REGION I  
Data Review Worksheets

X D. PESTICIDE INSTRUMENT PERFORMANCE (Section 4)

4. DBC Retention Time Check

List the percent difference for the dibutylchloredate (DBC) shift greater than 2% for packed columns, greater than 1.5% for wide-bore capillary columns, or greater than 0.3% for narrow-bore capillary columns.

<u>SAMPLE ID #'s</u>	<u>DBC % DIFFERENCE</u>	<u>ACTIONS</u>
----------------------	-------------------------	----------------

If the DBC does not meet the retention time criteria, the analysis may be flagged as unusable (R) for the affected samples, but qualification of the data is left up to the professional judgment of the reviewer. Discuss any qualification of the data below:

REGION I  
Data Review Worksheets

**XI      A.      PESTICIDE CALIBRATION (Sections 1 and 2)**  
(Form is for both organophosphorous pesticides and herbicides as well as organochlorine pesticides.)

1.      Initial Calibration

List the compounds which did not meet the Relative Standard Deviation (RSD) criteria of less than 20% for the initial calibration on the quantification column.

<u>DATE</u>	<u>COMPOUND</u>	<u>%RSD</u>	<u>COLUMN</u>	<u>SAMPLES AFFECTED</u>
-------------	-----------------	-------------	---------------	-------------------------

Flag all associated positive results as estimated (J) for samples which did not meet the %RSD criteria.

2.      Analytical Sequence

Did the laboratory supply the analytical sequence utilized and the appropriate retention time windows for each analyte in the check standard as per the requirements within the Method 8000 series in SW-846 3rd Edition and the Savannah Laboratories Incorporated QAPP?

Yes or No.

If no,

The data may be affected. The data reviewer must use professional judgment to determine the severity of the effect and qualify the data accordingly. Discuss any actions below. Refer to the Method 8000 series protocols for guidance on any action taken. Contact the laboratory to discuss any anomalies encountered to prevent reoccurrence on future analysis.

REGION I  
Data Review Worksheets

XI B. PESTICIDE CALIBRATION (Section 3)

J. Continuing Calibration

List the compounds which did not meet the percent difference (%D) criteria of  $\pm 15\%$  on the quantification column or  $\pm 20\%$  on the confirmation for the continuing calibration.

<u>DATE</u>	<u>COMPOUND</u>	<u>%D</u>	<u>COLUMN</u>	<u>SAMPLES AFFECTED</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

If the %D criteria is not met, flag all associated positive results as estimated (J).

REGION I  
Data Review Worksheets

**XII. SAMPLE QUANTIFICATION**

In the space below, please show a minimum of one sample calculation per fraction:

VOA:

BNA:

PEST/PCB:

## **XII. SAMPLE QUANTIFICATION (Continued)**

Organosporous pesticides

Herbicides

PCDD/PCDF

Organochlorine pesticides

### XIII. ADDITIONAL APPENDIX IX ORGANIC COMPOUNDS

Method specific validation checks involving Section A: Method 8150 (Herbicides); Section B: Method 8140 (Organophosphorous Pesticides); Section C: Method 8080 (Organochlorine Pesticide and PCBs),

- A. Method 8150's surrogate standard is 2,4-dichlorophenyl acetic acid (Water and Solid: 50-150%)

Surrogate Actions:

<u>Condition</u>	<u>Percent Recovery</u>		
	<u>&lt;10%</u>	<u>10%-R(MIN)</u>	<u>&gt;R(MAX)</u>
Positive Sample Results	J	J	J
Non-detected Results	R	UJ	advisory only

Note: The laboratory must report an acceptable surrogate recovery range as per the requirements of Sections 8.3 of Method 8150. As such, the Method 8150 surrogate spike acceptance window is 50-150% for waters. The R(MIN) is 50% and R(MAX) is 150%.

### XIII. ADDITIONAL APPENDIX IX ORGANIC COMPOUNDS (Continued)

#### Section A. (continued)

Method 8150's MS/MSD's are 2,4-D, Dinoseb, 2,4,5-T and 2,4,5-TP (Silvex).

List the Method 8150 (Herbicides) percent matrix spike recoveries and RPDs of compounds which do not meet the criteria listed in Table 8150.

<u>Fraction/ MS or MSD</u>	<u>Compound</u>	<u>% Rec/RPD</u>	<u>QC Limits</u>
--------------------------------	-----------------	------------------	------------------

**TABLE 8150: HERBICIDES**

<u>Parameter</u>	<u>Matrix Spike (a)</u>				<u>Surrogate Spike</u>	
	<u>Precision</u>		<u>Accuracy</u>		<u>Accuracy (c)</u>	
	<u>RPD% (b)</u>		<u>% of Recovery</u>		<u>% of Recovery</u>	
	<u>Water</u>	<u>Solids</u>	<u>Water</u>	<u>Solids*</u>	<u>Water</u>	<u>Solids</u>
SW-846 (3rd Ed.) Method 8150						
Herbicides:						
2,4-D	50	50	40-140	40-140	--	--
2,4,5-TP	50	50	40-140	40-140	--	--
2,4,5-T	50	50	40-140	40-140	--	--
2,4-Dichlorophenylaceticacid	--	--	--	--	50-150	50-150

- (a) Matrix spike precision and accuracy goals, where stated, are found in EPA method references and will be used as starting points. Limits developed in-house by the laboratory will be used and updated throughout the program.
- (b) "RPD" = relative percent difference. Precision is expressed according to the type of measurement (i.e., for field duplicates precision is expressed as the RPD between duplicate results).

\* Adopted from Savannah Labs.



### XIII. ADDITIONAL APPENDIX IX ORGANIC COMPOUNDS (Continued)

B. The PACE Laboratories surrogate standard for Method 8140 is triphenyl phosphate.

For waters the acceptance window is 23-176%

For solids the acceptance window is 28-174%

The Savannah Laboratories surrogate standard for Method 8140 is Ronnel.

For waters the acceptance window is 45-135%

For solids the acceptance window is 22-127%

<u>Condition</u>	<u>Percent Recovery</u>		
	<u>&lt;10%</u>	<u>10%-R(MIN)</u>	<u>&gt;R(MAX)</u>
Positive Sample Results	J	J	J
Non-detected Results	R	UJ	advisory only

Method 8140's MS/MSD compounds are: dimethoate, thionazin, sulfotepp, disulfoton, ethylparathion, famphur, methylparathion and phorate. Refer to Table 8140.

List the Method 8140 (Organophosphorous Pesticide) percent recoveries and RPD's of compounds which do not meet the criteria.

<u>Fraction/ MS or MSD</u>	<u>Compound</u>	<u>% Rec/RPD</u>	<u>QC Limits</u>
--------------------------------	-----------------	------------------	------------------

TABLE 8140: ORGANOPHOSPHOROUS PESTICIDES

<u>Parameter</u>	<u>Relative % Difference</u>		<u>Matrix Spike Accuracy % of Recovery</u>		<u>Surrogate Spike Accuracy % of Recovery</u>	
	<u>Water</u>	<u>Solids</u>	<u>Water</u>	<u>Solids</u>	<u>Water</u>	<u>Solids</u>
SW-846 Method 8140						
<u>Organophosphorus Pesticides:</u>						
Ethylparathion	50	50	20-140	20-140	--	--
Disulfoton	50	50	20-140	20-140	--	--
Sulfotep	50	--	20-140	20-140	--	--
Triphenylphosphate	--	--	--	--	23-176	28-174
Ronnel					45-135	22-127

## ADDITIONAL APPENDIX IX ORGANIC COMPOUNDS (Continued)

### C. Method 8080 (Organochlorine Pesticide and PCBs)

The surrogate standard is dibutylchlorendate.

For waters the acceptance window is 24-154%

For solids the acceptance window is 20-150%

Surrogate Actions:

<u>Condition</u>	<u>Percent Recovery</u>		
	<u>&lt;10%</u>	<u>10%-R(MIN)</u>	<u>&gt;R(MAX)</u>
Positive Sample Results	J	J	J
Non-detected Results	R	UJ	advisory only

### XIII. ADDITIONAL APPENDIX IX ORGANIC COMPOUNDS (Continued)

#### C. METHOD 8080 (Organochlorine Pesticide and PCBs) (Continued)

Note: The MS/MSD compounds are: gamma - BHC, heptachlor, aldrin, dieldrin, endrin and 4,4'-DDT. Refer to Table 8080.

List the Method 8080 (Organochlorine Pesticide and PCBs) percent recoveries and RPDs of compounds which do not meet the criteria listed in Table 8080.

If any compound does not meet the RPD criteria, flag positive results for that compound as estimated (J).

<u>Fraction/ MS or MSD</u>	<u>Compound</u>	<u>% Rec/RPD</u>	<u>QC Limits</u>
--------------------------------	-----------------	------------------	------------------

TABLE 8080: ORGANOCHLORINE PESTICIDES AND PCBs

Parameter	Matrix Spike (a)				Surrogate Spike	
	Precision		Accuracy (c)		Accuracy (c)	
	RPD% (b)		% of Recovery		% of Recovery	
	Water	Solids	Water	Solids	Water	Solids
<u>Pesticides/Polychlorinated</u>						
<u>Biphenyls:</u>						
gamma-BHC	15	50	56-123	46-127	--	--
Heptachlor	20	31	40-131	35-130	--	--
Aldrin	22	43	40-120	34-132	--	--
Dieldrin	18	38	52-126	31-134	--	--
Endrin	21	45	56-121	42-139	--	--
4,4'-DDT	27	50	38-127	23-134	--	--
Dibutylchlorendate	--	--	--	--	24-154	20-150

- (a) Matrix spike precision and accuracy goals, where stated, are found in EPA Organic Statement of Work (2-88, current revision).
- (b) "RPD" = relative percent difference. Precision is expressed according to the type of measurement (i.e., for field duplicates precision is expressed as the RPD between duplicate results).
- (c) The matrix spike recoveries for both water and solids are all EPA-CLP-SOW (2-88) derived limits. The advisory Dibutylchlorendate (DBC) surrogate recoveries for both water and solids are EPA-CLP-SOW (3/90) derived.

#### **XIV.Dioxin**

CLP 12/90 SOW for Tetra-Octa - Full Scan Tetra-Octa chlorinated dibenzo-p-dioxins and dibenzofurans including 2,3,7,8-TCDD

Refer to Appendix B for Dioxin Summary Forms. QAPP QA/QC criteria for dioxins are listed below:

#### **QC REQUIREMENTS IN CLP 12/90 SOW FOR PCDD/PCDFs**

<b>Audit Required</b>	<b>Frequency of Audits</b>	<b>Limits</b>	<b>Corrective Action by Lab</b>	<b>Action by Validator</b>
All Internal Standards  Samples outside the above criteria:	Every Sample	a) S/N > 10:1 b) 25% R ≥ 150	Reextraction, reanalysis of the affected sample	*
Cleanup std  Samples outside the above criteria:	Every Sample	a) S/N > 10:1 b) 25% R ≥ 150	Reextraction, reanalysis of the affected sample	*

- \* Since corrective action from lab should eliminate the problem, there should be no action required by the reviewer. If QC outliers still exist after lab's corrective action, then professional judgement must be used to qualify affected data appropriately.

**XIV. Dioxin****QC REQUIRMENTS (continued)**

<b>Audit Required</b>	<b>Frequency of Audits</b>	<b>Limits</b>	<b>Corrective Action by Lab</b>	<b>Action by Validator</b>
Method Blank	1 per 20 samples per matrix	a) No noise or chemical interference > 5% of signal of I.S. b) A confirmed analyte cannot exceed 2% of signal of I.S.	Reextraction, reanalysis of associated samples	*
Samples outside the above criteria:				
Duplicate	1 per 20 samples	50% RPD	Flat data (X)	Qualify data J for this sample
Samples outside the above criteria:				

\* Since corrective action from lab should eliminate the problem, there should be no action required by the reviewer. If QC outliers still exist after lab's corrective action, then professional judgement must be used to qualify affected data appropriately.

**XIV. Dioxin****QC REQUIRMENTS (continued)**

<b>Audit Required</b>	<b>Frequency of Audits</b>	<b>Limits</b>	<b>Corrective Action by Lab</b>	<b>Action by Validator</b>
Matrix Spike	1 per 20 samples	50% $\leq$ %R $\leq$ 150%	Flag data (Y)	Qualify data J for this sample

Samples outside  
the above criteria:

Resolution and retention window check	At beginning of a 12-hour sequence	25% valley between the 2378-TCDD and closest eluting isomers	Rerun resolution and retention window check	*
---	---------------------------------------	--	--	---

Samples outside  
the above criteria:

\* Since corrective action from lab should eliminate the problem, there should be no action required by the reviewer. If QC outliers still exist after lab's corrective action, then professional judgement must be used to qualify affected data appropriately.



XIV. Dioxin

## QC REQUIRMENTS (continued)

Audit Required	Frequency of Audits	Limits	Corrective Action by Lab	Action by Validator
ICAL (initial calibration) 5-point	Prior to any sample analysis	a) %RSD $\leq$ 15% b) 25% valley between the 1234-/2378-TCDDs c) 50% valley between 123478-/123678-HxCDDs d) S/N $\geq$ 2.5 (analytes) e) S/N $\geq$ 10 (standards) f) Retention times within 10 sec. from the CC3 analysis	Rerun ICAL	*

Samples outside the above criteria:

CCAL (daily calibration (mid-point))	At beginning of a 12-hour sequence	a) %D $\leq$ 30% from the ICAL b) 25% valley between the 1234-/2378-TCDDs c) 50% valley between 123478-/123678-HxCDDs	Rerun CCAL. If fails, then rerun ICAL	*
--------------------------------------	------------------------------------	---	--	---

Samples outside the above criteria:

\* Since corrective action from lab should eliminate the problem, there should be no action required by the reviewer. If QC outliers still exist after lab's corrective action, then professional judgement must be used to qualify affected data appropriately.

**XIV.Dioxin****QC REQUIREMENTS (continued)**

<b>Audit Required</b>	<b>Frequency of Audits</b>	<b>Limits</b>	<b>Corrective Action by Lab</b>	<b>Action by Validator</b>
Sensitivity CC1 check	At the end of a 12-hour sequence	S/N $\geq$ 50 for all analytes	Reanalysis of all samples in samples set (start new 12-hour sequence)	*

Samples outside  
the above criteria:

- \* Since corrective action from lab should eliminate the problem, there should be no action required by the reviewer. If QC outliers still exist after lab's corrective action, then professional judgement must be used to qualify affected data appropriately.

# ORGANIC REGIONAL DATA ASSESSMENT

REFERENCE NO.:  
LABORATORY: SLI, PACE  
SW846, 3RD EDITION

SITE: CIBA-GEIGY CORP., CRANSTON, RI  
NO. OF SAMPLES/ MATRIX:  
REVIEWER'S NAME:  
COMPLETION DATE:

## DATA ASSESSMENT SUMMARY

	<u>VOA</u>	<u>BNA</u>	<u>PEST</u>	<u>Organo-P,CL PESTICIDES</u>	<u>HERBICIDES</u>	<u>PCDD PCDF</u>
1. HOLDING TIMES	_____	_____	_____	_____	_____	_____
2. GC/MS TUNE/INSTR. PERFORMANCE	_____	_____	_____	_____	_____	_____
3. CALIBRATIONS	_____	_____	_____	_____	_____	_____
4. BLANKS	_____	_____	_____	_____	_____	_____
5. SURROGATES RECOVERIES	_____	_____	_____	_____	_____	_____
6. MS/MSD (QC)	_____	_____	_____	_____	_____	_____
7. OTHER QC	_____	_____	_____	_____	_____	_____
8. INTERNAL STANDARDS	_____	_____	_____	_____	_____	_____
9. COMPOUND IDENTIFICATION	_____	_____	_____	_____	_____	_____
10. SYSTEM PERFORMANCE	_____	_____	_____	_____	_____	_____
11. OVERALL ASSESSMENT	_____	_____	_____	_____	_____	_____

✓ = Data had no problems/or qualified due to minor problems.  
 ✓ = Data qualified due to major problems.  
 Z = Data unacceptable.  
 X = Problems, but do not affect data.

### ACTIONS ITEMS:

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### AREAS OF CONCERN:

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**APPENDIX A**  
**MATRIX SPIKE PERCENT RECOVERIES AND RPD MAXIMUMS**

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**MS/MSD QA/QC CRITERIA  
VOLATILES**

<u>Parameter</u>	<u>Matrix spike(a)</u>			
	<u>Precision</u>		<u>Accuracy (a)</u>	
	<u>Water</u>	<u>Solids</u>	<u>Water</u>	<u>Solids</u>
<u>Volatiles</u>				
Trichloroethene	14	24	71-120	62-137
Benzene	11	21	76-127	66-142
Toluene	13	21	76-125	59-139
Chlorobenzene	13	21	75-130	60-133
1,1-Dichloroethene	14	22	61-145	59-172
Toluene-d8	NA	NA	(c)	(c)
4-Bromofluorobenzene	NA	NA	(c)	(c)
1,2-Dichloroethane-d4	NA	NA	(c)	(c)

- (a) Matrix spike precision and accuracy goals, where stated, are found in the EPA CLP-SOW (3/90, current revision).
- (b) "RPD" = relative percent difference. Precision is expressed according to the type of measurement (i.e., for field duplicates precision is expressed as the RPD between duplicate results).
- (c) Surrogate compound recoveries are listed on page 9 of 28 of the Data Review Worksheets.

NA = Not applicable.

**MS/MSD QA/QC CRITERIA  
SEMIVOLATILES**

<u>Parameter</u>	<u>Matrix spike(a)</u>			
	<u>Precision</u>		<u>Accuracy (a)</u>	
	<u>RPD %(b)</u>		<u>% of Recovery</u>	
	<u>Water</u>	<u>Solids</u>	<u>Water</u>	<u>Solids</u>
<u>GC/MS Semivolatiles:</u>				
Phenol	42	35	12-89	26-90
2-Chlorophenol	40	50	27-123	25-102
1,4-Dichlorobenzene	28	27	36-97	28-104
N-Nitroso-di-n-propyl-amine	38	38	41-116	41-126
1,2,4-Trichlorobenzene	28	23	39-98	38-107
4-chloro-3-methylphenol	42	33	23-97	26-103
Acenaphthylene	31	39	46-118	31-137
4-Nitrophenol	50	50	10-80	11-114
2,4-Dinitrotoluene	38	47	24-96	28-89
Pentachlorophenol	50	47	9-103	17-109
Pyrene	31	36	26-127	35-142
Nitrobenzene-d5	NA	NA	(c)	(c)
2-Fluorobiphenyl	NA	NA	(c)	(c)
p-Terphenyl-d14	NA	NA	(c)	(c)
2-Fluorophenol	NA	NA	(c)	(c)
2,4,6-Tribromophenol	NA	NA	(c)	(c)
Propazine	18*	5*	34-118*	77-100*
Tinuvin-327	15*	6*	47-123*	77-107*

(a) Matrix spike precision and accuracy goals, where stated, are found in the EPA CLP-SOW (3/90, current revision).

(b) "RPD" = relative percent difference. Precision is expressed according to the type of measurement (i.e., for field duplicates precision is expressed as the RPD between duplicate results).

(c) Surrogate compound recoveries are listed on page 9 of 28.

NA = Not applicable.

\* These values were calculated based on data collected from the reagent spike blanks and fine sediment samples. These data will be updated as more data points become available throughout the project.

**MS/MSD QA/QC CRITERIA  
PESTICIDE/PCBs**

Matrix spike(a)				
<u>Parameter</u>	<u>Precision RPD %(b)</u>		<u>Accuracy (a) % of Recovery</u>	
	<u>Water</u>	<u>Solids</u>	<u>Water</u>	<u>Solids</u>
<u>Pesticides/Polychlorinated</u>				
<u>Biphenyls:</u>				
gamma-BHC	15	50	56-123	46-127
Heptachlor	20	31	40-131	35-130
Aldrin	22	43	40-120	34-132
Dieldrin	18	38	52-126	31-134
Endrin	21	45	56-121	42-139
4,4'-DDT	27	50	38-127	23-134
Dibutylchlorendate	NA	NA	(c)	(c)

(a) Matrix spike precision and accuracy goals, where stated, are found in the EPA CLP-SOW (3/90, current revision).

(b) "RPD" = relative percent difference. Precision is expressed according to the type of measurement (i.e., for field duplicates precision is expressed as the RPD between duplicate results).

(c) Surrogate compound recoveries are listed on page 9 of 28.

NA = Not applicable.

**APPENDIX B**  
**DIOXIN SUMMARY FORMS**  
**METHOD 8280 (FULL-SCAN)**  
**TETRA - OCTA**

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## **APPENDIX C**

### **DIRECT INJECT MONITORING SECTION**

**(Soil/Water Matrix : Appendix IX VOA Analytes :  
Methacrylonitrile, 1,4-Dioxane and Isobutanol)**

---

## **INTRODUCTION**

This section has been incorporated to assess the validity of three Appendix IX analytes that will be analyzed by a direct injection method involving the soil/water matrix samples only. These compounds are:

- methacrylonitrile
- 1,4-dioxane
- isobutanol

This section will cover the acceptance windows and QA/QC criteria items that differ for these compounds from those reported in the main worksheet. These include:

- Surrogate recoveries (Form II : Appendix C - Table 1)
- Matrix spike / matrix spike duplicate recoveries (Form III : Appendix C - Table 2)
- GC/MS - BFB Tune Criteria (Form V : Appendix C - Table 3)
- Initial Calibration Check (Form VI : Appendix C - Table 4)
- Continual Calibration Check (Form VII : Appendix C - Table 5)
- Form V will be utilized only to assess laboratory method blank/field sample associations. No QA/QC acceptance windows are involved with this form.

All other criteria (ie, holding times) will follow the standard procedures of the main worksheet.

Region I  
Data Review Worksheets

TABLE 1  
SOIL/WATER DIRECT INJECTION  
SURROGATE SPIKE RECOVERIES

Surrogate Spike Recoveries

List the percent recoveries that do not meet the criteria for surrogate recovery.

Sample ID No.	Toluene -d8	Bromofluorobenzene	1,2-Dichloroethane-d4
---------------	-------------	--------------------	-----------------------

QC limits soil:	84-138*	59-113*	70-121**
-----------------	---------	---------	----------

Surrogate

Actions Water:	88-110**	86-115**	76-114**
----------------	----------	----------	----------

\* These QC surrogate limits were laboratory derived (soil: toluene-d8 and bromofluorobenzene).

\*\* CLP derived limits.

<u>Condition</u>	<u>Percent Recovery</u>		
	<u>&lt;10%</u>	<u>10%-(MIN)</u>	<u>&gt;R(MAX)</u>

Positive sample results	J	J	J
Non-detected results	R	UJ	No Action

R(MIN): Denotes lower limit of surrogate recovery range window (ie, the VOA surrogate spiking standard toluene-d8) has a R(MIN) of 84% and a R(MAX) of 138%. The acceptance window is, therefore 84-138%.

Surrogate action should be applied:

1. If one surrogate is out of specification, regardless if the recovery is <10% or >10%.

Region I  
Data Validation Worksheet

**TABLE 2**  
**SOIL/WATER DIRECT INJECTION**  
**MATRIX SPIKE/MATRIX SPIKE DUPLICATE**

Matrix Spike/Matrix Spike Duplicate Recoveries and Precision MS/MSD Pair  
Sample ID No. \_\_\_\_\_, \_\_\_\_\_ Level \_\_\_\_\_

The acceptable surrogate recovery for 1,4-dioxane for both soil/water is 50%-150%.

Fraction			
<u>MS or MSD</u>	<u>Compound</u>	<u>% Rec/RPD</u>	<u>QC Limits</u>

QUALIFICATION IS LIMITED TO THE UNSPIKED SAMPLE ONLY.

1. If any compound does not meet the recovery range, follow the actions stated below:

<u>Condition</u>	<u>Percent Recovery</u>		
	<u>&lt;10%</u>	<u>10%-R(MIN)</u>	<u>&gt;R(MAX)</u>
Positive sample results	J	J	J
Non-detected results	R	UJ	No Action

R(MIN): Denotes lower limit of matrix spike recovery range window (ie, 1,4-dioxane (water matrix): 50%). R(MAX) for 1,4-dioxane (water matrix) is 150%. The acceptance window is, therefore, 50-150%).

2. If any compound does not meet the RPD criteria (15% maximum for all three compounds), flag positive results for that compound as estimated (J).

A separate worksheet should be used for each MS/MSD pair.

Region I

Data Review Worksheets

**TABLE 3**  
**SOIL/WATER DIRECT INJECTION**  
**GC/MS Tuning (BFB)**

**BFB-GC/MS Tuning**

If mass calibration is in error, refer to the Region guidelines for expanded criteria. .  
If necessary, qualify all associated data as unusable (R).

The BFB performance results were reviewed and found to be within the specified criteria.

If no,

Samples affected:

Note: The three analytes are VOA Appendix IX analytes. As such, only the BFB criteria is applied. Again, the data reviewer should realize that the BFB tune criteria for CLP and SW-846 protocols are the same.

Region I  
Data Review Worksheet

**TABLE 4**  
**SOIL/WATER DIRECT INJECTION**  
**INITIAL/CONTINUAL CALIBRATION**

Date of Initial Calibration:  
Dates of Continuing Calibrations:  
Instrument ID:  
Matrix/Level:

<u>Date</u>	<u>Criteria Out</u> RF, %RSD, RF, %D	<u>Compound (Value)</u>
_____	Samples Affected:	
_____	Samples Affected:	
_____	Samples Affected:	
_____	Samples Affected:	
_____	Samples Affected:	
_____	Samples Affected:	
_____	Samples Affected:	
_____	Samples Affected:	

1. All RFs must be >0.05
2. All %RSDs must be <30%
3. All %Ds must be <25%

Action:



1. If any compound has an initial RF or a continuing RF of  $<0.05$ :
  - a. Flag positive results for that compound as estimated (J).
  - b. Flag non-detects for that compound as unusable (R).
  
2. If any compound has a %RSD  $>30\%$  or a %D  $>25\%$  for volatiles and  $>30\%$  for semivolatiles:
  - a. Flag positive results for that compound as estimated (J).
  - b. Flag non-detects for that compound as estimated (UJ) if the %RSD or %D is  $>50\%$ .

A separate worksheet should be filled out for each initial curve.

## **APPENDIX D**

### **LIST OF CHANGES FROM THE REGION I DATA VALIDATION WORKSHEETS FOR CLP ANALYSES TO BE APPROPRIATE FOR SW-846 APPENDIX IX ANALYSES**

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## **APPENDIX E**

### **LIST OF CHANGES FROM FEBRUARY 1991 VALIDATION WORKSHEETS**

Cover Page

1. Add "Revision #1" after Edited for Appendix IX Compounds.
2. Delete "Laboratory: Savannah Laboratories  
Address "
3. Change date from December 1991 to January 1992

Page ii

1. Add "Appendix E" List of Changes from February 1991 Validation Worksheets in this document.

Page 1 of 31

1. Definitions and Qualifiers: Define "U" as "Compound analyzed but not detected."  
Delete "ND"

Page 8 of 31

1. Blank actions: No 5x rule and 10x for common contaminants?
2. Blank actions, "2  
... report the concentration found with the U qualifiers.

Page 9 of 31

1. Sample ID#'s:

Add \*\* to TOL, 4-BFB, PHL

Remove \*\* from (WATERS) 110, 115, and (SOLIDS) 113

Remove \* from (WATERS) 110, and (SOLIDS) 138, 113

2. \* - Reference changes from lab derived to CLP 3/90. Limits remain the same.
3. \*\* - Change SOW: 2-88 to SOW: 3-90

Page 10 of 30

1. 2nd sentence: Delete "The Laboratory (Savanna Laboratories, Inc.) will reference" ...  
The sentence will read: The USEPA 3/90 SOW guidelines for percent recoveries and RPD maximums on the Standard EPA Form III will be used for evaluation of data.

Page 11 of 31

1. Move the last sentence (The reviewer must use...) to the bottom of the page.

Page 13 of 31

1. Move "Sample ID" to the right side of the page.

Page 14 of 31

1. Move "Standard ID" to the right side of the page.

Page 15 of 31

1. Move "Compound" to the right side of the page.

Page 16 of 31

1. Move "Standard ID" to the right side of the page.

Page 22 of 31

1. A: Change Limit 40-160% to 50-150%.
2. Note: Change 40-140% to 50-150%  
Change R(MIN) from 40% to 50%  
Change R(MAX) from 140% to 150%

Page 24 of 31

1. Table 8150:  
  
Add "\*" beside solids  
Delete N/A. Replace with, \*Adopted from Savannah Labs.
2. Replace numbers as follows:

<u>Water</u>	<u>Solids</u>	<u>Water</u>	<u>Solids</u>	<u>Water</u>	<u>Solid</u>
50	50	40-140	40-140	---	---
50	50	40-140	40-140	---	---
50	50	40-140	40-140	---	---
---	---	---	---	50-150	50-150

Page 25 of 31

1. Surrogate used by PACE was TPP: window water = 23-176%  
window soil = 28-174%  
  
Surrogate used by SLI was Ronnel: window water = 45-135%  
window soil = 22-127%

2. Toluene: Solid RPD = 24  
Solid % Recovery = 62-137

Page A-2

1. Propazine: Water RPD = 50                      Soil RPD = 50  
Water % Recovery = 40-140                      Soil % Recovery = 40-140
2. Tinuvin-327: Water RPD = 50                      Soil RPD = 50  
Water % Recovery = 40-140                      Soil % Recovery = 40-140
3. Add:

	RPD		% Recovery	
	<u>Water</u>	<u>Soil</u>	<u>Water</u>	<u>Soil</u>
Irgasan-DP-300	50	50	40-140	40-140
Tofrasil	50	50	40-140	40-140
Butazolidin	50	50	40-140	40-140

4. Delete \* footnote

Appendix B

Delete entire Appendix B

**INORGANIC ANALYSES**  
**USEPA REGION I WORKSHEETS**  
**EDITED FOR APPENDIX IX COMPOUNDS**

**Prepared by:**

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**Prepared for:**

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410 SWING ROAD  
GREENSBORO, NORTH CAROLINA 27419**

**JANUARY 1992**



## INORGANIC REGION I WORKSHEET

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External laboratories have been sub-contracted by CIBA-GEIGY to analyze the 19 Appendix IX inorganic compounds. As such, the following Inorganic Region I Data Validation Worksheets have been modified accordingly for each analytical method to conform to the QA/QC criteria of each SW-846 test method in Table 1 on the following page.

**TABLE 1**  
**SELECTED ANALYTICAL METHODS FOR**  
**INORGANIC APPENDIX IX ANALYSES**

SW-846 Method	General Category/ Analyte	Technique	Number of Analytes Measured
6010	Metals	ICP	11
7041	Antimony	GFAA	1
7060	Arsenic	GFAA	1
7421	Lead	GFAA	1
7470	Mercury	CVAA	1
7740	Selenium	GFAA	1
7841	Thallium	GFAA	1
9012	Cyanide	Colorimetric	1
9030	Sulfide	Titrimetric	1
TOTAL			19

- ICP - Inductively Coupled Plasma Spectrometry (all metals other than GFAA or CVAA)
- GFAA - Graphite Furnace Atomic Absorption Spectrometry (normally only arsenic, antimony, lead, selenium, and thallium)
- CVAA - Cold Vapor Atomic Absorption Spectroscopy (mercury analyses only)

# INORGANIC METALS

## SUMMARY TABLES

---

REGION I

Site Name \_\_\_\_\_

Reference Number \_\_\_\_\_

**REGION I REVIEW OF INORGANIC LABORATORY DATA PACKAGE  
BY SW-846 (3RD EDITION) ANALYTICAL METHODS**

The hardcopied (laboratory name) \_\_\_\_\_ data package received at WCC has been reviewed and the quality assurance and performance data summarized. The data review included:

Matrix:

SDG. No.:

No. of Samples:

Sample Identifiers:

Equipment Blank No.:

Field Dup Nos.:

Sampling Date(s):

Shipping Date(s):

Date Rec'd by Lab:

SW-846 (3rd Edition) requires that specific analytical work be done. The general criteria used to determine the performance were based on an examination of:

-Data Completeness

-Holding Times

-Calibrations

-Blanks

-ICP Interference Check Results

-Matrix Spike Recoveries

-Laboratory Duplicates

-Field Duplicates

-Lab Control Sample Results

-Furnace AA Results

-ICP Serial Dilution Results

-Detection Limit Results

-Sample Quantitation

Overall Comments:

REGION I  
Data Review Worksheets

I. DATA COMPLETENESS

MISSING INFORMATION

DATE LAB CONTACTED

DATE REC'D

Definitions and Qualifiers:

- J - Approximate data due to quality control criteria.
- R - Reject data due to quality control criteria.
- U - Analyte not detected.

Reviewer:

Date:

REGION I  
Data Review Worksheets

II. HOLDING TIMES

Complete table for all samples and circle the analysis date for samples not within criteria.

SAMPLE ID	DATE SAMPLED	HG DATE ANALYSIS	CYANIDE DATE ANALYSIS	OTHERS DATE ANALYSIS	pH	ACTION
--------------	-----------------	------------------------	-----------------------------	----------------------------	----	--------

METALS - 180 DAYS FROM SAMPLE COLLECTION  
MERCURY - 28 DAYS FROM SAMPLE COLLECTION  
CYANIDE - 14 DAYS FROM SAMPLE COLLECTION  
SULFIDE - 7 DAYS FROM SAMPLE COLLECTION

ACTION:

1. If holding times are exceeded all positive results are estimated (J) and non-detects are estimated (UJ).
2. If holding times are grossly exceeded, the reviewer may determine that non-detects are unusable (R).

REGION I  
Data Review Worksheets

III A. INSTRUMENT CALIBRATION (Section 1)

1. Recovery Criteria

List the analytes which did not meet the percent recovery (%R) criteria for Initial or Continuing Calibration.

<u>DATE</u>	<u>ICV/CCV#</u>	<u>ANALYTE</u>	<u>%R</u>	<u>ACTION</u>	<u>SAMPLES AFFECTED</u>
-------------	-----------------	----------------	-----------	---------------	-------------------------

ACTIONS:

If any analyte does not meet the %R criteria follow the actions stated below.

For Positive Results:

	<u>Accept</u>	<u>Estimate (J)</u>	<u>Reject (R)</u>
Metals	90-110%R	75-89%R, 111-125%R	<75%R, >125%R
Mercury	80-120%R	65-79%R, 121-135%R	<65%R, >135%R
Cyanide	85-115%R	70-84%R, 116-130%R	<70%R, >130%R

For Non-detected Results:

	<u>Accept</u>	<u>Estimate (UJ)</u>	<u>Reject (R)</u>
Metals	90-125%R	75-89%R	<75%R, >125%R
Mercury	80-135%R	65-79%R	<65%R, >135%R
Cyanide	85-130%R	70-84%R	<70%R, >130%R

REGION I  
Data Review Worksheets

III B. INSTRUMENT CALIBRATION (Section 2)

2. Analytical Sequence

- A. Did the laboratory use the proper number of standards for calibration as described in SW-846 (3rd Edition) method?  
There is no difference on the proper number of standards between the CLP-SOW and SW-846 methodology. Yes or No
- B. Were calibrations performed at the beginning of each day (or every 8 hours), whichever is more frequent? Yes or No
- C. Were midpoint calibration standards analyzed at the beginning of sample analysis and at a minimum frequency of ten percent? Yes or No
- D. Were the correlation coefficients for the calibration curves for AA, Hg, and CN  $\geq 0.995$ ? Yes or No

If No,

The data may be affected. Use professional judgement to determine the severity of the effect and qualify the data accordingly. Discuss any actions below and list the samples affected.



REGION I  
Data Review Worksheet

**IV A. BLANK ANALYSIS RESULTS (Sections 1-3)**

List the blank contamination in Sections 1 & 2 below. A separate worksheet must be used for soil and water blanks.

MATRIX: \_\_\_\_\_

1. Laboratory Blanks

<u>DATE</u>	<u>ICB/CCB#</u>	<u>PREP BL</u>	<u>ANALYTE</u>	<u>CONC./UNITS</u>
-------------	-----------------	----------------	----------------	--------------------

2. Equipment/Trip Blanks

<u>DATE</u>	<u>EQUIP BL#</u>	<u>ANALYTE</u>	<u>CONC./UNITS</u>
-------------	------------------	----------------	--------------------

REGION I  
Data Review Worksheets

**IV A. BLANK ANALYSES RESULTS (SECTIONS 1-3) Continued**

**3. Frequency Requirements**

- |   |           |
|---|-----------|
| A. Was a preparation blank carried through the entire analytical process for each matrix type or group of 20 samples, whichever is more frequent? | Yes or No |
| B. Was a reagent blank with a minimum of three standards run daily?   | Yes or No |
| C. If 20 or more samples were run, was a reagent blank analyzed along with a mid-range standard at a frequency of every 10 samples?               | Yes or No |

If No,

The data may be affected. Use professional judgement to determine the severity of the effect and qualify the data accordingly. Discuss any actions below, and list the samples affected.

REGION I  
Data Review Worksheet

IV B. BLANK ANALYSIS RESULTS (Section 4)

4. Blank Actions

The Action Levels for any analyte is equal to five times the highest concentration of that element's contamination in any blank. The action level for samples which have been concentrated or diluted should be multiplied by the concentration/dilution factor. No positive sample result should be reported unless the concentration of the analyte in the sample exceeds the Action Level (AL). Specific actions are as follows:

1. When the concentration is greater than the IDL, but less than the Action Level, report the sample concentration detected with a U.
2. When the sample concentration is greater than the Action Level, report the sample concentration unqualified.

MATRIX: \_\_\_\_\_

MATRIX: \_\_\_\_\_

<u>ELEMENT</u>	<u>MAX. CONC./</u> <u>UNITS</u>	<u>AL/</u> <u>UNITS</u>
----------------	------------------------------------	----------------------------

<u>ELEMENT</u>	<u>MAX. CONC./</u> <u>UNITS</u>	<u>AL/</u> <u>UNITS</u>
----------------	------------------------------------	----------------------------

REGION I  
Data Review Worksheets

IV B. BLANK ANALYSIS RESULTS (SECTION 4) Continued

NOTE: Blanks analyzed during a soil case must be converted to mg/kg in order to compare them with the sample results.

$$\text{conc. in ug/l} \times \frac{\text{volume diluted to (100 ml)}}{\text{weight digested (1 gram)}} \times \frac{1 \text{ liter}}{1000 \text{ ml}} \times \frac{1000 \text{ gms.}}{1 \text{ kg}} \times \frac{1 \text{ mg}}{1000 \text{ ug}} = \frac{\text{mg}}{\text{kg}}$$

Multiplying this result by 5 to arrive at the action level gives a final result in mg/kg which can then be compared to sample results.

The SW-846 (3rd Edition) requirement is that the calibration blank be within a three (3) standard deviation window of the mean blank value. As such, gross blank contamination warrants the data validator to contact the laboratory to verify this was performed. List all anomalies in the Inorganic Regional Data Assessment.

REGION I  
Data Review Worksheets

**V A. ICP INTERFERENCE CHECK SAMPLE (Sections 1 & 2)**

1. Recovery Criteria

List any elements in the ICS AB solution which did not meet the criteria for %R. SW-846 (3rd Edition) does warrant a  $\pm 20\%$  window of the true value. The laboratory in accordance with SW-846 Method 6010 must follow an established control limit of 1.5 times the standard deviation of the mean value. If reoccurring problems arise, contact the lab and determine if any deviation from this procedure has occurred.

<u>DATE</u>	<u>ELEMENT</u>	<u>%R</u>	<u>ACTION</u>	<u>SAMPLES AFFECTED</u>
-------------	----------------	-----------	---------------	-----------------------------

ACTIONS:

REGION I  
Data Review Worksheets

**V A. ICP INTERFERENCE CHECK SAMPLE (SECTIONS 1 AND 2) Continued**

If an element does not meet the %R criteria, follow the actions stated below:

	<u>PERCENT RECOVERY</u>		
	<50%	50-79%	>120%
Positive Sample Results	R	J	J
Non-detected Sample Results	R	UJ	A

**2. Frequency Requirements**

Were Interference QC samples run at the beginning and end of each batch analysis run or a minimum of twice per 8 hour working shift, whichever is more frequent?

Yes or No

If no,

The data may be affected. Use professional judgement to determine the severity of the effect and qualify the data accordingly. Discuss any actions below and list the samples affected.

REGION I  
Data Review Worksheets

V B. ICP INTERFERENCE CHECK SAMPLE (Section 3)

3. Report the concentration of any elements detected in the ICS A solution > 2xIDL that should not be present.

<u>ELEMENT</u>	<u>CONC. DETECTED IN THE ICS</u>	<u>CONC. OF INTERFERENTS IN THE ICS</u>		
		<u>CA</u>	<u>FE</u>	<u>MG</u>

Estimate the concentration produced by the interfering element in all affected samples. See guidelines for examples. List the samples affected by interferences below:

<u>SAMPLE AFFECTED</u>	<u>ELEMENT AFFECTED</u>	<u>SAMPLE CONC. (ug/L)</u>	<u>SAMPLE INTERFERENT CONC.</u>	<u>ESTIMATED INTERF.</u>
			<u>CA</u> <u>FE</u> <u>MG</u>	<u>(ug/L)</u>

REGION I  
Data Review Worksheets

**V B. ICP INTERFERENCE CHECK SAMPLE (SECTION 3) Continued**

**ACTIONS:**

1. In general, the sample data can be accepted without qualification if the sample concentrations of Ca, Fe, and Mg are less than 50% of their respective levels in the ICS solution.
2. Estimate (J) positive results for affected elements for samples with levels of interferents 50% or more of that in the ICS solution.
3. Reject (R) positive results if the reported concentration is due entirely to the interfering element.
4. Estimate (UJ) non-detected results for which false negatives are suspect.

**NOTE:**

Aluminum (Al) potentially interferes with antimony (Sb), arsenic (As), molybdenum (Mo), lead (Pb), thallium (Tl), boron (B), manganese (Mn) and selenium (Se). For this project, five of these elements (Sb, As, Tl, Pb and Se) will be analyzed by graphite furnace.

Aluminum is not a required Appendix IX analyte. The lack of aluminum analysis for this project will not affect the quality of data obtained by the ICP. Please note that boron and molybdenum are included in the raw data but are not listed on EPA Form I, these elements are not of concern for this particular investigation.

Give explanations for any actions taken below:



REGION I  
Data Review Worksheets

**VI. MATRIX SPIKE**

TR # \_\_\_\_\_

MATRIX: \_\_\_\_\_

**1. Recovery Criteria**

List the percent recoveries for analytes which did not meet the required criteria.

S - amount of spike added

SSR - spiked sample result

SR - sample result

<u>Analyte</u>	<u>SSR</u>	<u>SR</u>	<u>S</u>	<u>%R</u>	<u>Action</u>
----------------	------------	-----------	----------	-----------	---------------

REGION I  
Data Review Worksheets

Matrix Spike Actions apply to all samples of the same matrix.

ACTIONS:

1. If the sample concentration exceeds the spike concentration by a factor of 4 or more, no action is taken.
2. If any analyte does not meet the %R criteria follow the actions stated below:

	<u>PERCENT RECOVERY</u>		
	<u>&lt;30%</u>	<u>30%-74%</u>	<u>&gt;125%</u>
Positive Sample Results	J	J	J
Non-detected Results	R	UJ	No Action

2. Frequency Criteria

- |   |           |
|---|-----------|
| A. Was a matrix spike prepared at the required frequency? | Yes or No |
|---|-----------|

A separate worksheet should be used for each matrix spike pair.

## VII. LABORATORY DUPLICATES

List the concentrations of any analyte not meeting the criteria for duplicate precision. For soil duplicates, calculate the PQL in mg/kg using the sample weight, volume and percent solids data for the sample. Indicate what criteria was used to evaluate precision by circling either the RPD or PQL for each element.

MATRIX: \_\_\_\_\_

<u>Element</u>	<u>PQL*</u>		<u>Sample #</u>	<u>Duplicate #</u>	<u>RPD**</u>	<u>Action</u>
	<u>water</u> ug/L	<u>soil</u> mg/kg				
Antimony	60	6.0				
Arsenic	10	1.0				
Barium	20	2.0				
Beryllium	5	0.5				
Cadmium	5	0.5				
Chromium	10	1.0				
Cobalt	50	5.0				
Copper	25	2.5				
Lead	5	0.5				
Mercury	0.2	0.02				
Nickel	40	4.0				
Selenium	5	0.5				
Silver	10	1.0				
Thallium	10	1.0				
Tin	200	20.0				
Vanadium	50	5.0				
Zinc	20	2.0				
Cyanide	10	1.0				

Laboratory Duplicate Actions should be applied to all other samples of the same matrix type.

### ACTIONS:

1. Estimate (J) positive results for elements which have an RPD >20% for waters and >35% for soils.
  2. If sample results are less than 5x the PQL, estimate (J) positive results for elements whose absolute difference is >PQL, (2xPQL for soils). If both samples are non-detected, the RPD is not calculated (NC).
- \* No minimum detection limits are specified in SW-846. All PQLs are calculated. As such, all CLP-CRDLs will be substituted with the laboratory calculated PQLs for reporting purposes.
- \*\* Mean RPD of  $\pm 20\%$  or  $\pm 2$  standard deviations of the last 25 runs (whichever is less) for all analytes as warranted by SW-846 (3rd Edition) protocols will be utilized.

# **VIII. FIELD DUPLICATES**

List the concentrations of all analytes in the field duplicate pair. For soil duplicates, calculate the PQL in mg/kg using the sample weight, volume and percent solids data for the sample. Indicate what criteria was used to evaluate the precision by circling either the RPD or PQL for each element.

MATRIX: \_\_\_\_\_

<u>Element</u>	<u>PQL</u>		<u>Sample #</u>	<u>Duplicate #</u>	<u>RPD**</u>	<u>Action</u>
	<u>water</u> ug/L	<u>soil</u> mg/kg				
Antimony	60	6.0				
Arsenic	10	1.0				
Barium	20	2.0				
Beryllium	5	0.5				
Cadmium	5	0.5				
Chromium	10	1.0				
Cobalt	50	5.0				
Copper	25	2.5				
Lead	5	0.5				
Mercury	0.2	0.02				
Nickel	40	4.0				
Selenium	5	0.5				
Silver	10	1.0				
Thallium	10	1.0				
Tin	200	20.0				
Vanadium	50	5.0				
Zinc	20	2.0				
Cyanide	10	1.0				

Field Duplicate actions should be applied to all other samples of the same matrix type.

## **ACTIONS:**

1. Estimate (J) positive results for elements which have an RPD >30% for waters and >50% for soils.
  2. If sample results are less than 5x the PQL, estimate (J) positive results and (UJ) nondetected results for elements whose absolute difference is >2xPQL, (4xPQL for soils). If both samples are non-detected, the RPD is not calculated (NC).
- \* No minimum detection limits are specified in SW-846. All PQLs are laboratory calculated. As such, all CLP-CRDLs will be substituted with the laboratory calculated PQLs for reporting purposes.
- \*\* Mean RPD of  $\pm 20\%$  or  $\pm 2$  standard deviations of the last 25 runs (whichever is less) for all analytes as warranted based on SW-846 (3rd Edition) protocols will be utilized.

**IX. LABORATORY CONTROL SAMPLE**

1. Aqueous LCS

List any LCS recoveries not within the 80-120% criteria and the samples affected.

<u>DATE</u>	<u>ELEMENT</u>	<u>%R</u>	<u>ACTION</u>	<u>SAMPLES AFFECTED</u>
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Note: The SW-846 (3rd Edition) LCS recovery window is  $\pm 20\%$  which is equivalent to CLP requirements.

## IX. LABORATORY CONTROL SAMPLE

### 2. Solid LCS

List any analytes that were not within the control windows set by the vendors for the solid LCS sample. Lot specifications are available on request from the laboratory.

<u>ELEMENT</u>	<u>LCS CONC.</u>	<u>CONTROL WINDOWS</u>	<u>ACTION</u>	<u>SAMPLES AFFECTED</u>
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ACTIONS:

<u>AQUEOUS LCS</u>	<u>&lt;50%</u>	<u>51-79%</u>	<u>&gt;120%</u>
Positive Results	R	J	J
Non-detected Results	R	UJ	No Action

<u>SOLID LCS</u>	<u>&lt;EPA Control Windows</u>	<u>&gt;EPA Control Windows</u>
Positive Results	J	J
Non-detected Results	UJ	No Action

### 3. Frequency Criteria

A. Was an LCS analyzed for every matrix, every digestion batch, and every 20 samples?	Yes or No
---	-----------

**X A. FURNACE ATOMIC ABSORPTION ANALYSIS**

**1. Duplicate Precision**

\_\_\_\_\_ Duplicate injections must agree within  $\pm 20\%$ .

\_\_\_\_\_ If duplicate injections do not agree within  $\pm 20\%$  for samples/elements the laboratory must rerun and report the lowest coefficient of variation as per SW-846 (3rd Edition) protocols.

**2. Post Digestion Spike Recoveries**

\_\_\_\_\_ Spike recoveries met the 75-125% recovery criteria for all samples.

\_\_\_\_\_ Method of Standard Addition (MSA) is not being performed during any round of sampling. Refer to Action #3 below.

Note: CLP requirements rather than SW-846 requirements will be used for guidance when applying the qualification actions below.

**ACTIONS:**

1. Estimate (J) positive results if duplicate injections are outside  $\pm 20\%$  RSD or CV.
2. If the sample absorbance is  $<50\%$  of post digestion spike absorbance the following actions should be applied:

	<u>PERCENT RECOVERY</u>		
	<u><math>&lt;10\%</math></u>	<u>11%-84%</u>	<u><math>\geq 115\%</math></u>
Positive Sample Results	R	J	J
Non-detected Results	R	UJ	No Action

3. Estimate (J) sample results if MSA was required.

## XI. INDUCTIVELY COUPLED PLASMA (ICP) SERIAL DILUTION ANALYSIS

\_\_\_\_\_ Serial Dilutions were performed for each matrix and results of the diluted sample analysis agreed within ten percent of the original undiluted analysis as per CLP guidance and not SW-846 (3rd Edition) protocols.

Serial Dilutions were not performed for the following:

\_\_\_\_\_

\_\_\_\_\_ Serial Dilutions were performed, but analytical results did not agree within 10% for analyte concentrations greater than 50x the IDL before dilution.

Report all results below that do not meet the required laboratory criteria for ICP serial dilution analysis.

MATRIX: \_\_\_\_\_

ELEMENT	IDL	50xIDL	SAMPLE RESULT	SERIAL DILUTION	%D	ACTION
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Barium

Beryllium

Cadmium

Chromium

Cobalt

Copper

Nickel

Silver

Tin

Vanadium

Zinc

Actions apply to all samples of the same matrix.

ACTIONS:

1. Estimate (J) positive results if %D > 15.

Note: Sample result must be  $\geq 50x$  PQL for calculation by serial dilution; then use  $\pm 10\%$  original undiluted value as criteria.



## XII. DETECTION LIMIT RESULTS

### 1. Instrument Detection Limits

\_\_\_\_\_ Instrument Detection Limit results were present and found to be less than or equal to the Contract Required Detection Limits.

\_\_\_\_\_ IDLs were not included in the data package on Form X.

\_\_\_\_\_ IDLs were present, but the criteria was not met for the following elements: \_\_\_\_\_

### 2. Reporting Requirements

Were sample results on Form I reported down to the IDL not the CRDL for all analytes? Yes or No

Were sample results that were analyzed by ICP for Se, Tl, As, or Pb at least 5X IDL? Yes or No

Were sample weights, volumes, and dilutions taken into account when reporting detection limits on Form I? Yes or No

If No,

The reported results may be inaccurate. Make the necessary changes on the data summary tables and request that the laboratory resubmit the corrected data.

### XIII. SAMPLE QUANTTTATION

\_\_\_\_\_ Sample results fall within the linear range for ICP and within the calibrated range for all other parameters.

\_\_\_\_\_ Sample results were beyond the linear range/calibration range of the instrument for the following samples/elements:

---

In the space below, please show a minimum of one sample calculation per method:

Lab formula:  $\frac{\text{ug}}{\text{ml}} \times \frac{100 \text{ ml}}{\text{g}} = \text{ug/g (mg/kg)}$ : for solid samples

$\frac{\text{ug}}{\text{l}} \times \frac{100 \text{ ml}}{100 \text{ ml}} = \text{ug/l}$ : for aqueous samples

ICP

FURNACE

MERCURY

CYANIDE

REGION I  
Data Review Worksheets

For soil samples, the following equation may be necessary to convert raw data values (usually reported in ug/L) to actual sample concentrations (mg/kg):

The lab is required to use 1 gram sample (wet weight) to 100 ml.

Wet weight concentration =

$$\text{Solid digest conc. in } \frac{\text{ug}}{\text{L}} \times \frac{100\text{ml}}{1 \text{ gm}^*} \times \frac{1\text{L}}{1000\text{ml}} \times \frac{1000\text{gm}}{1\text{kg}} \times \frac{1\text{mg}}{1000 \text{ ug}} = \frac{\text{mg}}{\text{kg}}$$

\* Weight is between 1-2 grams as weighed by the analyst.

In addition the sample results are converted to dry weight using the percent solids calculations:

$$\frac{\text{Wet weight conc.}}{\% \text{solids}} \times 100 = \text{final concentration, dry weight (mg/kg)}$$

REFERENCE NO. \_\_\_\_\_ SITE \_\_\_\_\_  
LABORATORY \_\_\_\_\_ NO. OF SAMPLES/  
MATRIX \_\_\_\_\_  
SDG # \_\_\_\_\_  
REVIEWER (IF NOT ESD) \_\_\_\_\_  
SW-846 \_\_\_\_\_  
REVIEWER'S NAME \_\_\_\_\_  
COMPLETION DATE \_\_\_\_\_

DATA ASSESSMENT SUMMARY

	ICP	AA	Hg	CYANIDE
1. HOLDING TIMES	_____	_____	_____	_____
2. CALIBRATIONS	_____	_____	_____	_____
3. BLANKS	_____	_____	_____	_____
4. ICS	_____	_____	_____	_____
5. LCS	_____	_____	_____	_____
6. DUPLICATE ANALYSIS	_____	_____	_____	_____
7. MATRIX SPIKE	_____	_____	_____	_____
8. MSA (not performed)	__	__	__	__
9. SERIAL DILUTION	_____	_____	_____	_____
10. SAMPLE VERIFICATION	_____	_____	_____	_____
11. OTHER QC	_____	_____	_____	_____
12. OVERALL ASSESSMENT	_____	_____	_____	_____

O = Data had no problems/or qualified due to minor problems.

M = Data qualified due to major problems.

Z = Data unacceptable.

X = Problems, but do not affect data.

ACTION ITEMS: \_\_\_\_\_

AREAS OF CONCERN: \_\_\_\_\_